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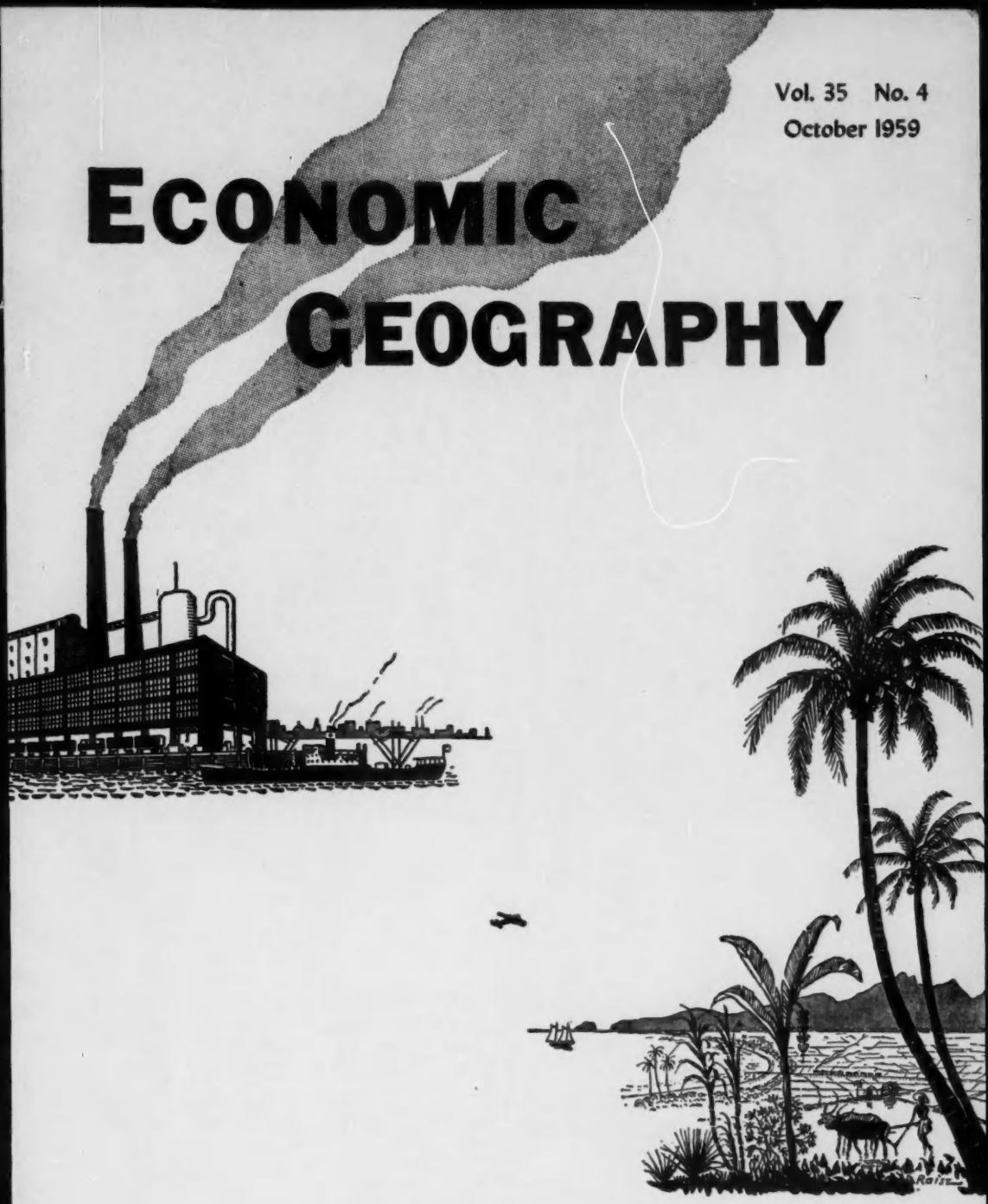

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CONSERVATION: MORE ETHICS THAN ECONOMICS

I have often wondered heretically if conservation could, as such, be considered a field of knowledge. Indeed I have long speculated as to whether conservation could in itself be defended as a clearly definable subject for a formal course in the school or college curriculum. That conservation is, however, a way of life, a state of mind, which should pervade every educational process of man, I think there can be no doubt.

In a cogent phrase, the late Aldo Leopold of the University of Wisconsin defined conservation as the attainment and maintenance of "a state of harmony between men and land." This is the conservation idea. This is the goal that in the interests of ultimate survival, man must not fail to attain. This is a destiny that society can achieve only through the rising crescendo of voices of individual men and women whose common convictions can not in the aggregate be denied.

The most profoundly persuasive case for the conservation idea with which I am familiar is carried in the central threads of the collection of Aldo Leopold's essays published under the title *A Sand County Almanac* (Oxford University Press, New York, 1949). Anyone who has not lived its pages has an inspiring and poetic intellectual experience before them. With this editorial, let me either remind you of, or draw your attention to, some of the more sober conclusions expressed in the pages of this little book.

To Leopold, the conservational concept was imbedded in the realm of moral and ethical behavior, of religion itself. He said: "All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts. His *instincts* prompt him to compete for his place in that community, but his *ethics* prompt him also to cooperate, perhaps in order that there may be a place to compete for."

Professor Leopold went on to observe that "conservation is getting nowhere because it is incompatible with our Abrahamic concept of land. We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man . . . ."

Let me in conclusion throw Leopold's gauntlet of challenge down before you: "Despite nearly a century of propaganda, conservation still proceeds at a snail's pace. . . . The usual answer to this dilemma is 'more conservation education.' No one will debate this, but is it certain that only the *volume* of education needs stepping up? Is something lacking in the *content* as well?

"It is difficult to give a fair summary of its content in brief form, but, as I understand it, the content is substantially this: obey the law, vote right, join some organizations, and practice what conservation is profitable on your own land; the government will do the rest.

"Is not this formula too easy to accomplish anything worthwhile? It defines no right or wrong, assigns no obligation, calls for no sacrifice, implies no change in the current philosophy of values. In respect of land-use, it urges only enlightened self-interest. Just how far will such education take us?"

Many a conservation project represents "a beautiful piece of social machinery, but all too often it is coughing along on two cylinders because we have been too timid, and too anxious for quick success, to tell the people involved the true magnitude of their obligations. Obligations have no meaning without conscience, and the problem we face is the extention of the social conscience from people to land.

"No important change in ethics was ever accomplished without an internal change in our intellectual emphases, loyalties, affections, and convictions. . . . Conservation has not yet touched these foundations of conduct. . . . In our attempt to make conservation easy, we have made it trivial."

In a word, and in the final analysis, conservation is ethics, not economics.

JOHN C. WEAVER

ECONOMIC GEOGRAPHY

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TOWARD A MORE GENERAL ECONOMIC GEOGRAPHY

H. H. McCarty

Dr. McCarty is Professor of Geography and Chairman of the Department of Geography, State University of Iowa.

SEVERAL years have elapsed since Raymond Murphy expressed the belief that, in the United States, economic geography has come to exist as "a whole group of fields rather than just one," that "general economic geography [has] ceased to exist as a research specialty," and that, "the scholar who claims penetration in his research thinks of himself as a specialist in land utilization, in resources, in manufacturing geography [or] in the geography of transportation . . . and makes no pretense to competence in research in economic geography as a whole."[1] Reviews of *American Geography: Inventory and Prospect*, in which these statements appear, have generally recognized their validity and at the same time have gone to considerable lengths to deplore the existence of such a condition in this major phase of geographic discipline.[2]

The lack of intellectual cohesion, comparability, and universality implied in Professor Murphy's statements appears to present a genuine challenge to research workers in economic geography. Any evaluation of such a challenge must, however, be viewed in the light of traditional goals and objectives in this branch of geographic discipline; and, by the same token, solutions to problems attributable to non-fulfillment of those objectives can be evaluated only in terms of that same traditional framework. Let us first direct our attention to a brief review of those intellectual aspirations.

SCOPE

There seems to be general agreement that the topical scope of economic geography shall be presumed to be coincident with the range of phenomena properly identified as *economic*.[3] In the evolution of geographic thought the term "economic" has generally been applied either to those kinds of human activities that result in the creation of useful goods and services, or to the goods and services themselves. Geographic usage of the term appears not to have deviated materially from the meanings employed in

[1] P. E. James and C. F. Jones, Edits: *American Geography: Inventory and Prospect*, Syracuse University, 1954, p. 241.

[2] See C. A. Fisher: *Econ. Geog.*, Vol. 31, 1955, p. 88; Olga Titlebaum: Trans. from *Izvestia Akadimii Nauk SSSR, Seria Geograficheskaia*, No. 1, Jan.-Feb. 1956, distributed by Chauncy D. Harris, Chicago, May 1956; Morgan Thomas: *Econ. Geog.*, Vol. 32, 1956, p. 77; William Warntz: *Papers and Proceedings of the Regional Science Association*, 1957, p. 118; and Rudolf Lutgens, Ed: *Erde und Weltwirtschaft. Ein Handbuch der allgemeinen Wirtschafts geographie*, passim. The latter work is admirably reviewed by Dieter Brunnschweiler in *Econ. Geog.*, Vol. 31, 1955, pp. 93–94, and Vol. 35, 1959, pp. 93–94.

[3] Richard Hartshorne: *The Nature of Geography*, Lancaster, Pennsylvania, 1939, pp. 400–401.

botany and geology (*useful* plants, *useful* minerals), or from those most commonly used in the business world, or in the discipline of economics. In all of these cases an *economic* phenomenon is most likely to be one that is concerned with the creation of goods or services. Economists know the processes by which such goods and services are created as the processes of production. Available evidence strongly supports the contention that if geographers continue to use the term "economic" in such a way as to make it virtually synonymous with the term "production," they will rarely be misunderstood by their colleagues in other disciplines. We shall therefore resume the argument under the assumption that for purposes of the present discussion, the topical scope of economic geography may be taken to include all phases of the production of goods and services, but to exclude, for the time being, all other types of economic phenomena.

OBJECTIVES

Throughout the long history of their research efforts economic geographers have sought to systematize those types of human knowledge that are concerned with the location and spatial arrangements of the features of production. There is a long-established tradition that, in approaching that goal, economic geographers shall be concerned with both the topical and regional aspects of those types of phenomena. Hartshorne has shown how a well-developed discipline requires systematization of both kinds of knowledge, how studies of the two types complement each other, and how both are essential to the existence of a unified field.[4] Our critics indicate that this kind of unification has not been achieved. Since lack of unity is most likely to be apparent in the regional aspects of a field, let us turn immediately to the intellectual needs encountered in that type of study.

In its regional phases, economic geography attempts to view individual elements in an area's system of production in the context of other social and natural features with which they are areally associated. Many of these associated features are other kinds of productive activities, which together form "element-complexes," concepts that are familiar to all students of geography.[5] Elements in those complexes are readily identified as the types of production with which a very large portion of the research studies in systematic economic geography have been concerned. Yet it appears that a means has not been found of relating such systematic studies either to each other, or to any central theme such as would be required in regional analysis. In this observation we appear to have reached the heart of the problem.

COMPARABILITY OF RESEARCH FINDINGS

Lack of comparability among research findings may be attributed to a considerable number of deficiencies, among which the following appear to be particularly important: (1) variations in the *scale* at which different studies are conducted, (2) divergent study *designs*, (3) multiplicity of *categories* used, and (4) lack of a common *measure* of importance. It is significant that the predominant emphasis in this list is on the inadequacies of the descriptive aspects of economic geography, the devices used by research students to identify the situations they analyze.

[4] *Ibid.*, p. 644.

[5] See comment by F. B. Kniffen in "Round Table on Problems in Cultural Geography," *Annals, Assoc. of Amer. Geographers*, Vol. 27, 1937, p. 164; also Richard Hartshorne, *op. cit.*, p. 428.

1. *Scale.*—An inherent lack of comparability among findings based on research projects conducted at different scales has long been recognized in geography.[6] Studies designed to provide the basis for a critical evaluation of the effects of these variations have produced promising results; and with the projected use of more precise research tools in these kinds of analyses, a basis for ultimate solution of this problem may soon be provided.[7] In the meantime, it is pertinent to observe that comparability of research findings would be materially improved if professional consensus concerning the most suitable scales for various types of studies could be achieved.

2. *Design.*—A considerable amount of research in economic geography has been designed in such a way that it cannot be either duplicated or verified, and thus be made to form a partial basis for the kinds of generalizations needed in a unified field. Variations in research designs, in the manner in which problems are stated and hypotheses are formulated and tested, and in the manner in which the results are related to what has previously been known about that particular subject, undoubtedly have contributed materially to the lack of unity with which we are concerned. Garrison has shown, however, that the general framework of statistical techniques can provide a study design that is flexible enough to meet the needs of a wide variety of types of geographic research.[8] In spite of considerable elements of uniqueness that occur in every geographic problem, there is no doubt that the employment of statistical concepts in the collection and analysis of data can provide generalizations which may be compared and thus made useable in general geographic analysis.

3. *Categories.*—An outstanding feature of the production concept lies in the ease with which this type of human activity may be divided and subdivided into an amazingly large number of extremely narrow categories. From the broad viewpoint of social science, it is quite possible to consider production activities as a single aspect of human behavior, a category that is readily distinguished from other types of activities that are associated with consumption, or politics, or numerous other phases of social life. In this context, it surely would be possible, although perhaps not very enlightening, to consider production as a homogeneous type of social activity, a single element that might be viewed as a part of an element-complex, a useful category in some very broad study of human geography. In analyzing the spatial arrangement of this type of activity, however, an investigator would soon be prompted to divide it into sub-types in order to permit him to arrive at a description that would be more meaningful in terms of the kinds of human problems his investigation was presumed to solve. This process of subdivision obviously can be carried to very great lengths, until the categories that may be required to describe the production activity in a given area are not only very narrow, but also very numerous.

Claims to scientific validity for research studies conducted by American

[6] Preston James: "Toward a Further Understanding of the Regional Concept," *Annals, Assoc. of Amer. Geographers*, Vol. 42, 1952, p. 205.

[7] See John C. Weaver: "The County as a Spatial Average in Agricultural Geography," *Geogr. Rev.*, Vol. 46, 1956, p. 536; Arthur Robinson: "The Necessity of Weighting Values in Correlation Analysis of Areal Data," *Annals of Assn. Amer. Geographers*, Vol. 46, 1956; and, H. H. McCarty, J. C. Hook, and D. S. Knos: *The Measurement of Association in Industrial Geography*, Iowa City, 1956, p. 10.

[8] William Garrison in *Geogr. Rev.*, Vol. 46, 1956, p. 427.

economic geographers appear to rest almost entirely in their findings concerning narrowly-defined categories of production. In many of these studies geographers appear to have achieved the conditions of objectivity, verifiability, and generality demanded by modern science; and the increasing popularity of studies conducted within a quantitative-analytical framework has been interpreted by many people as indicating a growing consensus that these types of research activities are more desirable than those conducted in other ways. There is no doubt that their impressions are strengthened by the current general intellectual emphasis on science in all phases of modern life.

The methodology of a carefully designed topical study is relatively simple, emphasizing accurate measurement, careful statement of a problem, elaboration and testing of hypotheses, and an estimate of the importance to the general body of knowledge in economic geography of the generalizations which were derived. It is these generalizations, however, that have so often been found unsuited to the needs of a comprehensive economic geography.

The research analyst who carries these same methodological criteria into his attempts to analyze the total economies of specific regions soon experiences frustration. In those areas he encounters a wide variety of economically-associated production activities whose characteristics can be identified and measured, but not compared quantitatively with each other. Existing topical studies provide only limited assistance because the generalizations they have produced cover only a minor fraction of the totality of economic activities and, also, because the diversity of units of measurement they employ make it virtually impossible to compare one type of production with another, to develop a satisfactory description of the magnitude of the economy as a whole, or to relate the importance of any one of its elements to such a totality. It appears that further consideration of this measurement problem could shed additional light on the situation we are considering.

4. *Measurement.*—Complications arising from the use of diverse units of measurement to describe the importance or magnitude of production activities have received only limited attention in geographic literature, although these problems are of extreme importance in any attempt to maintain comparability among research findings. These problems, which arise out of the use of varying measures of magnitude, are the major concern of the present inquiry.

The situation is obviously complex and many-faceted, and we can hardly hope to dispose of its problems within the confines of the present paper, which should be considered primarily as an attempt to establish the nature of those problems rather than as a proposal for their complete solution. Expectations of finding a single "best" means of measuring economic importance obviously must be viewed as extremely visionary, because in the present state of our knowledge it appears that no such single measure exists. We can hope, however, to discover a means of measurement that will overcome the present lack of comparability among studies in economic geography *within some limited framework or in keeping with certain specific and clearly defined goals.* We have already identified those goals in terms of the desirability of developing a set of generalizations that will permit comprehensive analyses of production activities in specific areas and that will facilitate interaction between

systematic and regional studies of those same types of phenomena.

In the literature of economic geography it appears that three kinds of universal units of measurement have been used to achieve comparability among diverse types of production. These units may be classified according to whether they are stated in terms of land, labor, or the value of production.

(a) The land-area unit (which usually employs a standard areal unit such as an acre or square mile) has been used rather frequently in agricultural studies. It can hardly be considered a measure of production, since, in using it in that manner, one must assume that all types of land are equally productive and that all land units receive equally productive applications of capital and labor. For these same reasons, the areal unit appears to be entirely inapplicable to measuring non-agricultural types of production.

(b) Labor units, especially numbers of employees, have often been used in studies of manufacturing and other non-agricultural types of production. Available evidence (based mainly on U. S. data) suggests that the employment measure performs very well when studies are confined to a single industry, or a group of closely related industries in which employment practices and ratios of employees to capital utilization are nearly identical. It performs poorly, however, where production figures for divergent types of manufacturing must be compared, or where any of these must be compared with any of the service occupations, or with agriculture or mining. The employment measure also is likely to produce deceptive results wherever part-time work is common, and, for those situations, many analysts prefer the man-hour, the man-day, or a total payroll figure to perform the measurement function. Even these latter measures, however, fail to take account of the fact that worker productivity varies enormously from one occupation to another because of wide variations in skill as well as in the use of tools and machinery.[9]

(c) All of the preceding comment points to the desirability of using a value measure of production if suitable data can be obtained. It must be stipulated immediately, however, that the figures we would use must measure the *net* value of production, not the gross value; and that, furthermore, they must measure all kinds of production, regardless of whether the products are intended for sale in the market, or for use by the producer. The latter qualification is especially significant in areas where subsistence farming is important.

Economic geographers are most familiar with a net value measure in the concept, *value added by manufacture*, which is often used in manufacturing studies. Less common, but equally commendable, is the use of a net agricultural product figure, in which, for example, a meat-animal farm's gross product is reduced by the cost of purchased animals and feed, in order to obtain a measure of the volume of production on that particular farm. (It is just as incorrect to give an Iowa meat-

[9] A crude test of the comparability of employment data and estimates of net product (measured in terms of personal income, as defined by the U. S. Department of Commerce) may be obtained by correlating state totals for both series. In order to approximate average conditions, since employment data become available only at 10-year intervals, 1955 income data were compared with 1950 employment figures and the following representative coefficients of correlation were obtained ($N = 49$): total manufacturing 0.98; trade and services 0.99; construction 0.96; mining 0.83; agriculture 0.83. These are very broad categories. Lack of comparability among segments of those categories is illustrated by the contrast in value added by manufacture per U. S. worker in two major segments of manufacturing in 1954: $11,500 in the petroleum and coal products group, and $4,600 in the textiles group. (Data from the U. S. Census of Manufactures, 1954.)

animal farmer credit for producing the range animals he bought in Nebraska as to give a Gary steelmaker credit for the iron ore he obtained from Minnesota.) If data employing such a measure could be made available, the economic geographer would be able to state his problems in either narrow categories or broad ones and to consider all of the production aspects of a local economy simultaneously; and, to revert to Professor Murphy's earlier statement, it should be quite possible for him to give simultaneous and effective consideration to such diverse topics as land utilization, manufacturing, and transportation, as well as to the numerous other activities that are commonly concerned with production.

AVAILABILITY OF NET PRODUCT DATA

Gross national product data that are descriptive of the broad features of production are now made available annually for 56 nations of the world, and are published by the United Nations.[10] A considerable literature is available concerning techniques and methods used in the so-called systems of national accounts, in connection with which estimates of gross domestic product are derived.[11] These materials have been recommended reading for research economic geographers for several years.[12] For the present purpose, perhaps it will suffice to state that these estimates are generally accepted as providing the best available descriptions of national economies by those statisticians and economists of the world who have accepted the responsibility for measuring the performance of those economies.

Scales.—The geographer is interested not only in the reliability of these estimates, but also in whether they can be adapted to geographic use. It is inherent in the nature of systems of national accounts that production figures be aggregated at national levels, primarily because data for exports, imports, incomes, and a great variety of other economic phenomena are available most accurately for national political units. In some nations, notably the United States, satisfactory systems for allocating national figures to sub-national units such as states and provinces have been devised.[13] Further allocation of the state figures to counties has been undertaken in several states of the United States, generally by bureaus of business research of the state universities.[14] Extension of these activities to all of the states is envisioned; but progress along these lines has been slow. It appears, however, that economic geographers,

[10] Statistical Office of the United Nations, *Yearbook of National Accounts Statistics*, 1957, New York, 1958.

[11] Gross domestic product appears to be the most useful item in the U. N. compilations, in which it represents substantially the net value of production within a given nation, including both capital accumulation and items for export. This figure, broken down into eleven broad categories, is available for 38 nations; 17 others use a *net* domestic product figure, which is identical to the above figure, except that capital accumulation has been deducted. A good discussion of various features of these computations appears in the U. N.'s *National Income Statistics*, New York, 1950.

[12] In 1948, C. A. Fisher wrote, "The economist measures economic activity in terms of income, and now that figures of national incomes adequate for world-wide comparative purposes have been made available . . . it behooves us to make use of them." "Economic Geography in a Changing World" in *Transactions and Papers of the Institute of British Geographers*, Publication No. 14, London, 1949, p. 79.

[13] See U. S. Department of Commerce, *Personal Income by States since 1929*, a supplement to *Survey of Current Business*, issued in 1956. More recent data appear annually, usually in the August issues of the latter publication. Problems in the allocation of national data to smaller areas are well presented in National Bureau of Economic Research, *Regional Income*, Princeton, N. J., 1957; and in Lewis C. Copeland: *Methods of Estimating Income Payments in Counties*, Charlottesville, Va., 1952.

[14] County estimates for seven states in the southeastern United States for 1939 and 1947 may be found in *County Income Estimates for Seven Southeastern States*, Charlottesville, Va., 1952.

either individually or in cooperation with economists, might well undertake such allocation procedures in order to provide data at suitable scales for the areas in which they have research interests.

Categories.—Categories employed in published reports for systems of national accounts ordinarily are very broad, far broader, indeed, than those ordinarily used in systematic studies in economic geography. In this respect the national figures follow the widely-used "standard" industrial classifications, promulgated by many national governments, including the United States government, and by the United Nations.[15] These systems, which are roughly comparable, contemplate the entire range of production activities, breaking it down first into very broad categories such as "agriculture" and "manufacturing," and then sub-dividing those classes into narrower and narrower sub-categories, until a condition of extremely precise description is attained in the final breakdowns, which include several hundreds of separate categories. Published data are almost invariably expressed only in broad categories such as "agriculture" and "manufacturing," but suitable methods for sub-division of these categories have been devised, and data for performing such operations are rather generally available. Perhaps the most suitable concluding comment is twofold: (1) these classifications do, in reality, provide the comprehensiveness desired in research programs in economic geography; and (2) broader-category studies, involving data such as are now available, certainly would produce a more general economic geography, and may well be given serious consideration in geographers' plans for future research studies.

[15] See *Comparison of National Industrial Classification Schemes with the International Standard Industrial Classification of All Economic Activities*, United Nations, March, 1957; also *Standard Industrial Classification Manual*, Budget Bureau, Washington, 1957.

CONCLUSION

In spite of several obvious difficulties, it appears that data sufficient to establish the general characteristics of the economic development of relatively small areas in several important nations are within reach of the economic geographer who contemplates research activities in such areas. If his efforts are concerned mainly with broadly-defined aspects of production, such as agriculture, manufacturing, and trade, relatively little data manipulation will be necessary. And if he desires to divide these economies into narrower sectors, procedures are available that will, in most cases, enable him to measure the importance of those sectors, not only in terms of their absolute magnitude but also in terms of their relative importance in a local economic scene. If such an undertaking could be accomplished, it should provide economic geographers with the means not only of bringing much greater unity to their efforts, but also of producing a topically comprehensive economic geography.

Note: Professor McCarty has promised for a later issue a sequel to this article. In it he will apply to a section of the United States the ideas he has expressed in this paper.—The Editor.

THE AUSTRALIAN CBD

Peter Scott

Professor Scott is head of the Department of Geography at the University of Tasmania, Hobart. He was formerly on the staff of the Research School of Pacific Studies at the Australian National University, Canberra, who initially sponsored the research project of which this paper is a product.

SINCE the close of World War II, the central business districts of Australia's leading cities, in common with most other Western metropolitan centers, have suffered increasingly from traffic congestion and suburban competition in retail trade. In Australia, as in America, this has followed upon the rapid growth of urban population, the leveling of incomes, the greater proportion of incomes spent on retail purchases, and the ever growing use of private automobiles. As a result, many Australian business houses in the larger cities have preferred to establish branches in the rapidly developing suburbs, or in the centers of smaller cities, rather than extend their downtown premises. More recently, small regional shopping centers on the American pattern have made their appearance: the first was opened at Chermside, Brisbane, and the second at Ryde, Sydney, in 1957; a third is being built on the outskirts of Melbourne. Meanwhile, municipal authorities are taking a variety of remedial measures to try and stem the flow of trade to the suburbs.

Yet for all the importance of these city centers in Australian life and for all the complexity of their present problems, the Australian CBD has so far been the subject of but scanty geographical investigation. The writer has therefore undertaken a detailed field survey of the central areas of fourteen Australian cities, including the six state capitals which together house well over half the Australian population, in order to study the evolution and internal structure of the Australian CBD.

But since the scope of the surveys has been too broad to permit an adequate treatment of the findings within the compass of a single article, the present study will be largely confined to an analysis of the internal ground-floor structure of the Australian CBD as exemplified by the capital cities. A comparative analysis of these cities, which range in population from one hundred thousand to nearly two million, sheds some light on the process of segregation and dispersal, as well as on the changing character and associations, of land-use elements with increasing city size. Accordingly, the fascinating individuality of each CBD will be drawn upon only in so far as it is necessary to account for apparent anomalies in the evolutionary process. The paper concludes with a brief discussion on the possible significance of the findings for the geographical examination and description of smaller centers.

The CBDs of the Capital Cities

On completing the central-area surveys of the capital cities,[1] their CBDs

[1] The surveys were carried out between June, 1956, and November, 1957. Those of Sydney, Brisbane, Adelaide, and Perth were supported by the Australian National University, Canberra, and of Melbourne and Hobart by the University of Tasmania.

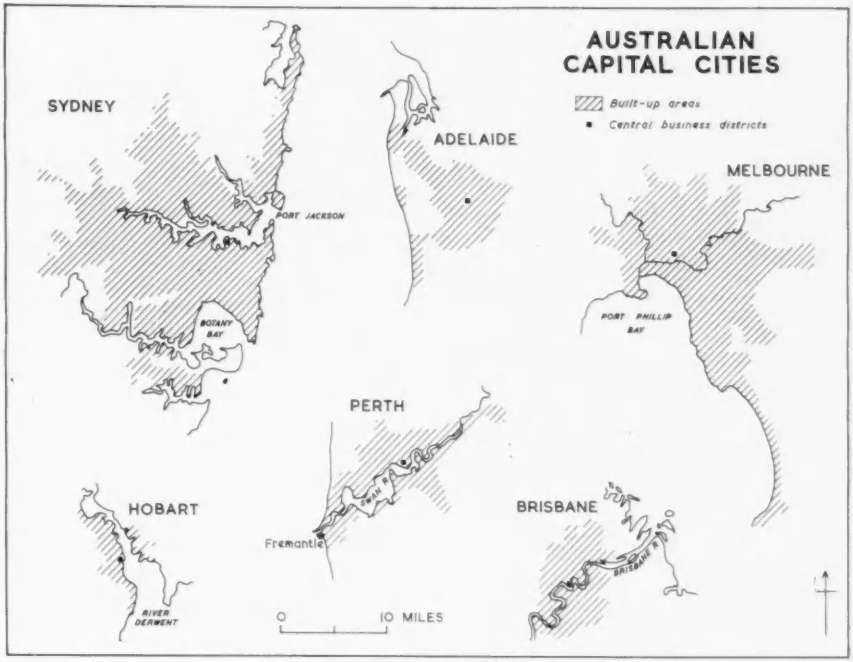

FIG. 1.

were delimited by applying the Central Business Index Method advanced by Murphy and Vance (Fig. 2).[2] The areas thus defined tend to be elongated along dominant parallel streets and to increase in area roughly in proportion to increasing city size (Table 1).[3] Sydney's CBD, in sharp contrast to Melbourne's, is fairly rigidly circumscribed by barriers to outward expansion. Accordingly, it occupies a smaller surface area, but has greater vertical development (Fig. 3), more sharply differen-

[2] Raymond E. Murphy and J. E. Vance, Jr.: "Delimiting the CBD," *Econ. Geog.*, Vol. 30, 1954, pp. 189–222. The main problem encountered was whether to delimit a block by named streets. The centers of Melbourne and Adelaide are broken by innumerable transverse lanes and avenues, all of them named, and these permit considerable differentiation of land use within the blocks. After some investigation it was decided to accept these thoroughfares as block boundaries for the purpose of delimitation. For clarity most side streets have been excluded from the accompanying maps.

[3] Proportionately to population they would seem to be a good deal smaller than the American CBDs studied by Murphy and Vance.

TABLE 1

METROPOLITAN POPULATION AND CBD CHARACTERISTICS OF THE AUSTRALIAN STATE CAPITAL CITIES

(Population in thousands. Area in acres. Distance in yards)

City	*Sydney*	*Melbourne*	*Brisbane*	*Adelaide*	*Perth*	*Hobart*
1954 Population	1,863	1,524	502	484	349	95
CBD area	175	182	138	111	96	40
Hub from geographic center	95	210	210	150	35	95

tiated land values, greater traffic congestion, and suffers more from suburban competition.[4] Sydney's traffic problems are further aggravated by its narrow streets, which are much narrower than the main streets of Melbourne; in the office quarter especially, there is an oppressive lack of organic relationship between street plan and building height. Suburban competition in Sydney is also favored by the location of the CBD; in none of the other capital cities, except perhaps Hobart, is the CBD so far off center (Fig. 1). However, Brisbane's CBD, though fairly central, is likewise almost wholly surrounded by natural barriers. Otherwise none of the cities other than Sydney and Brisbane has barriers across the dominant axes, and only the million cities show a marked upward growth.

[4] From June, 1954, to June, 1957, the population of Sydney rose by 6 per cent and of Melbourne by 10 per cent, but the volume of retail sales in the CBD in Sydney increased by only 3 per cent and in Melbourne by nearly 15 per cent. See *Retail Merchandiser*, Vol. 6, No. 2, June, 1958, pp. 8–12.

STRUCTURAL ZONES AND COMPONENT ELEMENTS

Each CBD has a distinctive zonal structure comprising not only separate retail and office districts but also inner and outer retail zones. The inner zones are characterized by stores selling personal requisites and demanding a central location; these zones tend to be compact. In Figure 2 they have been delimited by the extent of the strongly nucleated group of department, variety, and women's clothing stores.[5] The

[5] The inner retail and office zones were delimited on the basis of at least 50 per cent of the ground-floor central business frontage of the side of a block, or a contiguous portion of a block, devoted to either department, variety and

(*Continued on next page*)

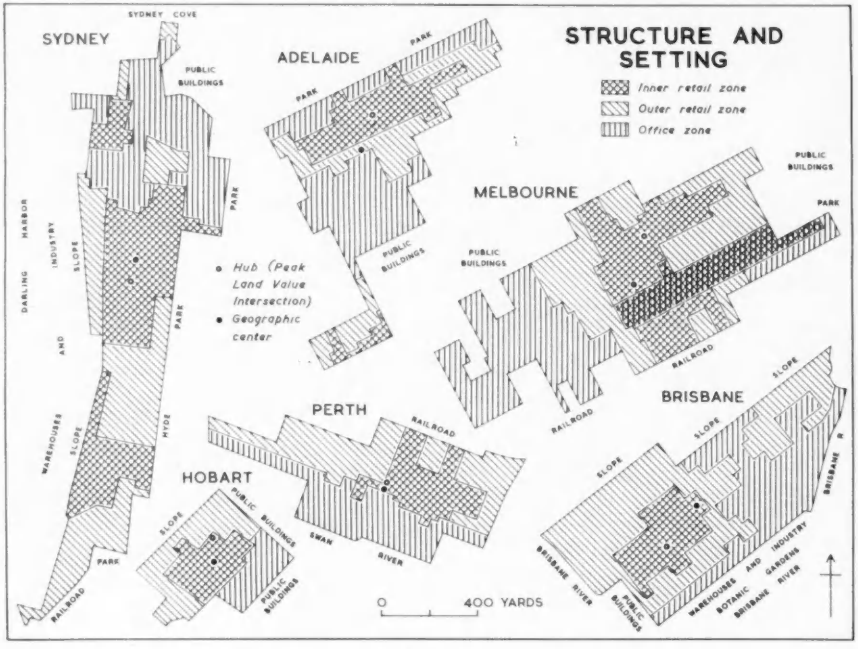

FIG. 2.

FIG. 3. Sydney's CBD, which is fairly rigidly circumscribed by barriers to outward expansion, with one of these barriers—Darling Harbor—in the foreground. Sydney's CBD has the greatest vertical development of any CBD in Australia. (Photograph by courtesy of the Australian News and Information Bureau.)

outer zones are characterized by stores retailing household goods and services; they tend to encircle the inner zones, but because their component elements are more diverse and less interrelated than are those of the inner zones, the outer zones tend to be discontinuous. Both Sydney and Adelaide have secondary inner zones, mostly of low-grade stores; but whereas in Sydney the secondary nucleus lies within a continuous shopping area, in Adelaide it is cut off from the main shopping district by the office quarter. In Brisbane, where the outward expansion of the CBD is hampered on all sides and where there are few approaches to the core, a secondary nucleus has emerged north of the CBD in Fortitude Valley. Perth has the embryo of a secondary nucleus north of the railway. Aside from the secondary nuclei and except for the sharp northern edge of Melbourne's core, the inner zones are exposed along the CBD edge only where confronted by barriers such as along the parks in Sydney and Adelaide (Fig. 4) and along the railways in Melbourne and Perth. Where the office quarters abut directly onto the

women's clothing stores, together with associated retail outlets and services catering distinctively for women, or to offices respectively. In the case of the mixed zone in Melbourne, however, at least one-third of the frontage but not as much as one-half is devoted to each of these two functions. The outer retail zone has at least 50 per cent of its frontage devoted to retailing and, in general, at least 50 per cent to stores retailing household goods and services; but in places the percentage for these stores falls below 50 per cent, though they remain the dominant function. Since it was not intended to calculate the areas of the zones, their boundaries were simplified with regard to the buffer lots with non-CBD uses.

inner zones, as in Sydney, Perth, and Hobart, the line of demarcation between them tends to be particularly rigid. However, some of the outer retail areas, as in Melbourne, Adelaide, and especially Brisbane, at present function *inter alia* as buffers between the office and inner retail zones.

The location of the office district relative to the component retail zones has an important bearing on how near the peak land value intersection (hereinafter called the hub) approaches to the geographic center. In the two smallest CBDs, stores selling personal goods are largely confined to the center block, so that the corner with the highest land values is inevitably peripheral to the inner retail zone. In the larger cities, however, the hub tends to be fairly central to this inner zone; this holds even for Melbourne, if its primary inner zone be taken as terminating against the mixed belt to the south. But in Melbourne, Brisbane, and especially Adelaide, the location of the office quarter is such that the hub is some distance off the geographic center. Moreover, since the current building expansion in the Australian CBD is almost wholly confined to the office quarter, this gap between the hub and the geographic center would seem to be widening. In one sense this is markedly true of Sydney, where the office district has leapfrogged across the Harbor and is rapidly developing on the north shore. But aside from this aspect, the location of the office quarter in Sydney, as well as in Perth and Hobart, has helped to pivot the CBD not far from the hub.

FIG. 4. Adelaide's CBD, with Grenfell Street in the left foreground and Pulteney Street in the right foreground. Note the barrier to the northward expansion of the CBD. (Photograph by courtesy of the Australian News and Information Bureau.)

In each CBD three geographically distinct types of land-use elements are discernible. Although their distributions would seem to be generally significant irrespective of city size, their significance nevertheless becomes more readily apparent as the CBD evolves. Firstly, there are what might be termed the primary elements, which are almost entirely concentrated in one or other of the three zones. Next there are the secondary elements, which overlap two of the three zones but tend to predominate in the one with which they have stronger organic associations. Finally, there are the dispersed elements which are scattered through the CBD.[6] Since the number of elements is particularly large, they will be divided somewhat arbitrarily into major or minor elements according as to whether more or less than 60 units are present in all the capital cities. Except for department and variety stores, and the individual types of food and women's clothing stores, only the more numerous elements are depicted on the accompanying maps. Only those depicted will be discussed below.

The general arrangement of land-use elements within the CBD will be analyzed by reference to the department stores,[7] which exert the main pull of central shopping districts. The mean point[8] of distribution of department stores will be called the retail node, and the sequence of land-use elements outward from the node has been determined by reference to their mean points of distribution. Although the hub has been used as the point of reference by other workers, in all the Australian capital cities it lies farther from the centers of gravity of retail trade, as evidenced by the mean points of the various retail distributions by trade type, than does the retail node. In fact, all six cities have the mean points of retail distributions concentrated in one direction away from the hub: in Brisbane, northward; in Perth, eastward; and in the other cities, southward.

In detail, however, the arrangement of land-use elements within the CBD can only be understood by reference to pedestrian flows between each department store or group of stores, classified by quality and type of trade, and the main traffic terminals feeding shoppers into the centers.

THE RETAIL NODE

In general, department stores tend to cater for either the middle and higher income classes or the popular and middle classes.[9] The former use quality and service as their main appeal and generally occupy central sites; the latter depend on price appeal and accordingly are usually some distance from the hub. In Brisbane the lower income level stores are even outside the CBD in the Valley, while in Sydney and Adelaide they lie some distance south of the hub (Fig. 5. In Sydney, however, Mark Foys caters for the higher-quality trade). In Melbourne

[6] The classification of land-use elements into these categories has to some extent been confirmed by relating their ranked percentage distribution among the three functional zones to the theoretical curve used by John C. Weaver in his "Crop-Combination Regions in the Middle West," *Geogr. Rev.*, Vol. 44, 1954, pp. 175–200. The primary elements are thus confined to a single zone, the secondary elements have a two-zone combination, and the dispersed elements a three-zone combination.

[7] A department store was defined, following Jefferys, as "a large retail store with 4 or more separate departments under one roof, each selling different classes of goods of which one is women's and children's wear." See James B. Jefferys: *Retail Trading in Britain, 1850–1950* (Cambridge, England, 1954), pp. 325–326 and 465.

[8] The mean point was used in preference to the median point because it is influenced by all locations within the distribution.

[9] H. Pasdermadjian: *The Department Store: Its Origins, Evolution and Economics* (London, 1954), p. 84.

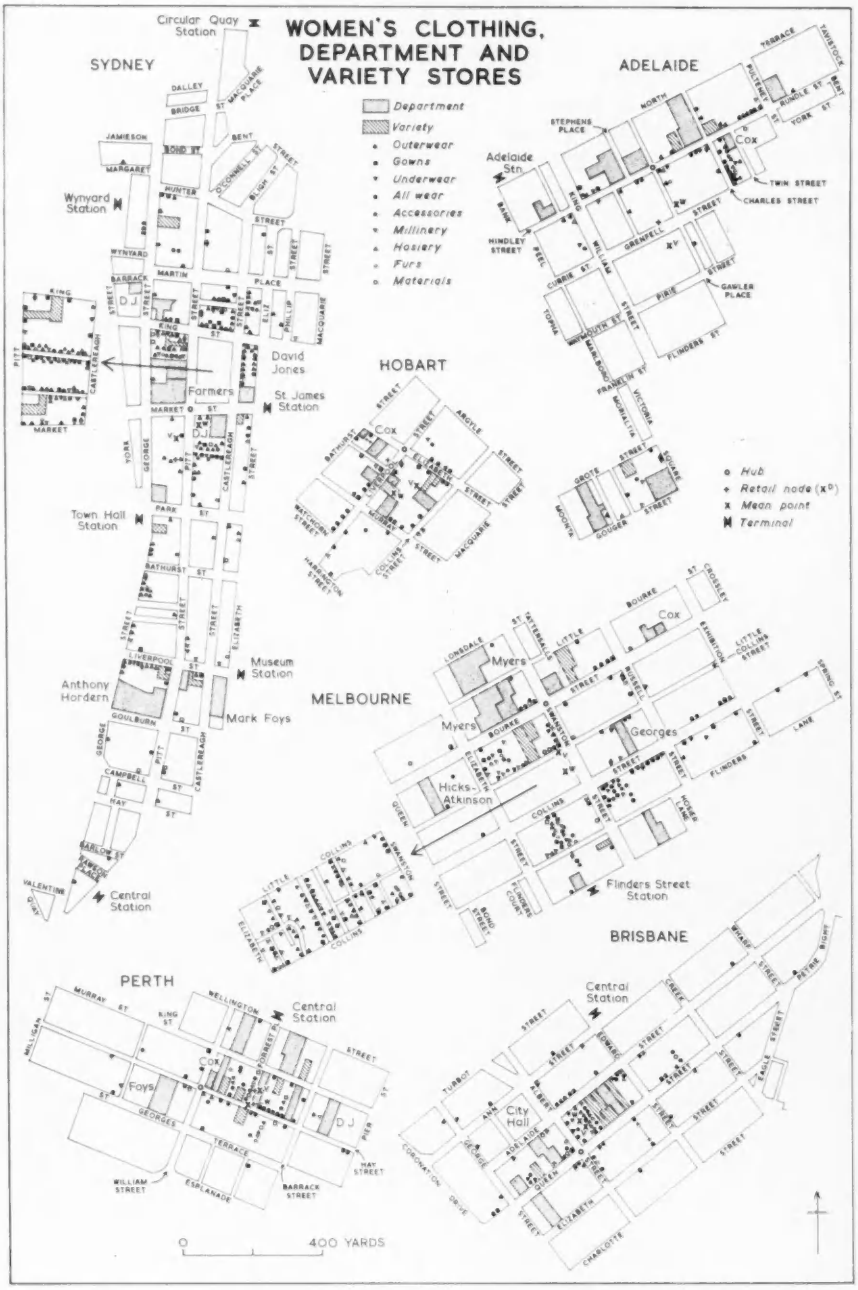

FIG. 5. Department, variety, and women's clothing stores in the CBDs of the state capital cities. On this and the subsequent maps, the mean points for each city refer to the mean points of distribution of the retail types depicted. Since the retail node is the mean point for the distribution of department stores, this figure merely depicts as such the mean points for variety and women's clothing stores; the symbols are lettered V and W respectively. Note that the westernmost blocks of Melbourne and Perth, in which none of these stores occur, have been excluded.

the popular stores are northeast of the hub, in Perth immediately adjacent to the hub, and in Hobart north of the hub. In all cities they tend to have a higher percentage of their sales in home furnishings and a lower percentage in clothing accessories than in the higher income level stores. Some may even be engulfed among outer retail elements.

Melbourne alone has stores that are markedly individualistic in their class of trade. Although David Jones has the widest appeal of any Sydney store, it cannot be compared with the Myers Emporium in Melbourne which embraces the entire price range (Fig. 6). This would be remarkable in any large store. Yet Myers ranks among the largest department stores in the world, and has a turnover greater than that of the four largest establishments in Sydney combined. It is in fact Myer's dominance of the metropolitan market, together with the channelling of most of Melbourne's city shoppers through Flinders Street Station, that accounts for the abrupt northern edge of Melbourne's inner zone. Melbourne is also exceptional in that Georges is the only department store in Australia catering exclusively for the wealthy. Like Hicks-Atkinson, which caters for the more selective office worker, it is situated on rising ground away from and above the hurly-burly plains that extend from Flinders Street Station to Myers.

FIG. 6. Bourke Street, Melbourne, viewed northeastward from the intersection with Elizabeth Street. Bourke, like Lonsdale, Collins, Flinders, and all north-south streets in Melbourne, is 99 feet wide; alternate east-west streets measure only 33 feet. Beyond the Elizabeth Street Post Office is the Myers Emporium, which in turnover ranks among the largest department stores in the world and is by far the largest in Australia. The next intersection beyond Myers, that of Bourke and Swanston, is the hub, or peak land value intersection. Beyond the hub the land begins to rise and retailing to specialize in the popular trade. At the northeastern end of Bourke Street is Parliament House. (Photograph by courtesy of the Australian News and Information Bureau.)

FIG. 7. Hay Street, the principal shopping street in Perth, viewed southeastward from the hub. Of the major thoroughfares in Central Perth, Hay Street is not only the busiest for vehicular traffic but also the narrowest; it has a carriageway width of only 36 feet. Since the main shopping block lies north of Hay Street, and since offices and bus terminals are in St. George's Terrace to the south, the mid-block pedestrian crossings to the east of the hub are the busiest in the city; they add considerably to the traffic congestion. Variety stores occur near the crossings on both sides of Hay Street, while four of the city's eight department stores are located on the north side between the hub and the next intersection to the east. (Photograph by courtesy of the Australian News and Information Bureau.)

In all the capital cities, department stores, though tending to cluster, yet prefer to be some distance apart. For although the drawing power of department stores makes them the focus of central shopping districts, the stores themselves derive considerable consumer attraction from neighboring specialty shops. In Adelaide, where the principal shops are confined to a single street, five of the six stores—like five of the six stores in the main street of Memphis (population also over 480,000)[10]—are spaced out along the shady side; the sixth specializes in the popular trade. Each of the other capital cities has a central block containing two or three stores, while the remaining blocks with department stores have, with one exception, only one store apiece. In sum, no less than two-thirds of all the stores recorded occur each in a separate block, even though only one occupies an island site.

[10] P. H. Sisco: *The Retail Function of Memphis*, Univ. of Chicago, Dept. of Geogr., Research Paper No. 37, 1954, map facing p. 61.

PRIMARY INNER RETAIL ELEMENTS

In the inner retail zone the sequence of the primary elements outward from the node was found to be variety stores, footwear, women's clothing, and theaters. In general, the retail node tends

to nestle among fairly closely packed mean points, but in each city the arrangement is modified by, *inter alia*, the pattern of pedestrian flows. Thus in Sydney, where the inner zone is served mainly by four underground stations, the node is remarkably central to the distribution of mean points. In Melbourne and Brisbane, however, where pedestrian flows are largely channelled between the department stores and a single traffic terminal, the points lie between the terminal and the node. But notwithstanding the individuality of each city, the outward sequence remains strikingly consistent.

All variety stores of the Woolworths type occupy key positions. Typically they are to be found either between department stores or near traffic terminals or both—wherever pedestrian flows are heaviest. It is in fact symptomatic of pedestrian flows in the million cities that three out of eight variety stores in Sydney are along Pitt Street north of the hub, whereas three out of four in Melbourne are between Myers and Flinders Street. Sydney even has a variety store opposite Wynyard Station, which serves both the inner retail and office zones. In all the other cities, the variety and department stores are closely integrated, though in Brisbane too the variety stores are generally nearer the station—and, therefore, the office district—than are the department stores. In Perth, the lone variety store seemingly on the wrong side of the main street is actually near the two pedestrian crossings most frequented by office workers at lunchtime.[11] In both Perth and Hobart the busiest side of the main retail block has two stores and second busiest one, but in Perth these sides are opposite and in Hobart adjacent.

Women's clothing stores are by far the most numerous of all the specialty outlets in the CBDs. Since they are highly sensitive to location, the patterns they present will be readily explicable, especially for Melbourne, by the obvious pedestrian routes. But it will be less readily apparent, except perhaps for Melbourne, that the patterns reveal, particularly for four of the cities, three main clusters distinguishable by their quality.[12] Thus aside from the major concentrations of medium-grade stores near the node or hub, a cluster of high-grade stores is discernible either near professional offices, as near Georges along gracious tree-lined Collins Street in Melbourne, or oriented toward the office zone but virtually contiguous to the main concentration, as in the other cities. As for low-grade stores, they are mostly outside the CBD in Brisbane and Perth, but in the other cities they present distinct clusters located toward or among the department stores serving the popular trade.

The provision of women's clothing outlets shows some significant variations with city size. In general, the number of shops retailing either outerwear only or underwear only varies roughly in proportion to CBD area, but those selling a wide range of women's wear number much the same in all cities and predominate in Hobart and Perth. On the other hand, specialists in one type of goods, such as gowns, millinery, hosiery, accessories, and furs, are very few in the four smaller centers, but are particularly numerous in the million cities. Even so, the outlets for hosiery and furs are minor primary elements.

[11] Gordon Stephenson and J. A. Hepburn: *Plan for the Metropolitan Region, Perth and Freemantle, Western Australia*, 1955 (Perth, W.A., 1955), p. 180.

[12] *Cf.*, Richard U. Ratcliff: *The Problem of Retail Site Selection*, Michigan Business Studies, Vol. 9, No. 1, 1939, p. 67. Ratcliff recognizes only "the popular-price district" and "a concentration of fashionable apparel shops."

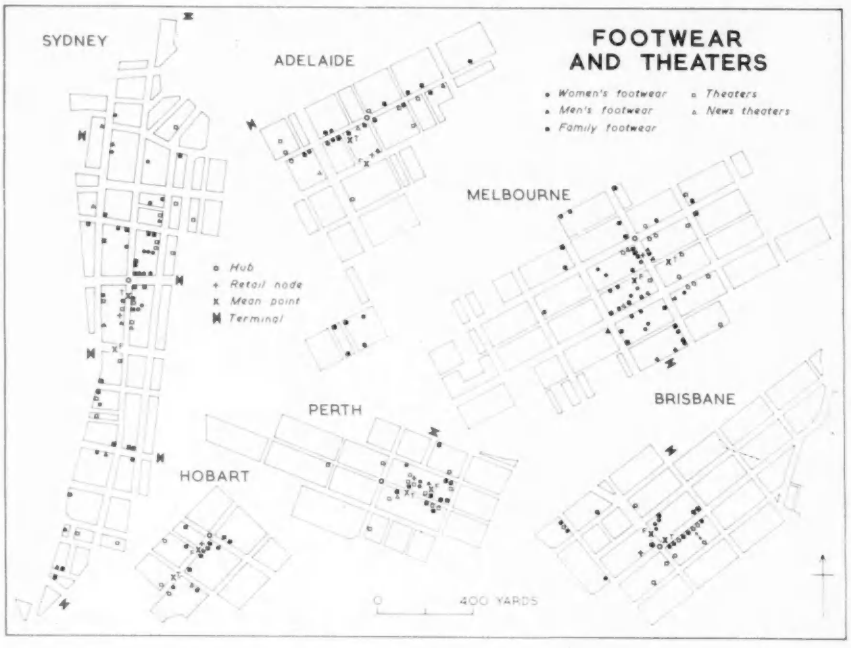

FIG. 8.

In location, however, the variation would seem to be more with the nature of the street plan than with city size. Thus shops selling all women's wear occupy peripheral main-street sites in all cities; they typify the low-grade quarters of Melbourne and Hobart, and rank as major secondary elements. Those retailing either outerwear only or underwear only are primary elements situated nearer the node, but they are nevertheless scattered through the main clusters of women's stores and typify the low-grade quarter of Sydney. Moreover, judging by the patterns in Melbourne, Adelaide, and Perth, they would seem to prefer sites off the main streets; but where these are not available, as in the other cities, they are perforce chiefly on the main streets. In this regard the small-scale specialists in Melbourne and Sydney present a striking contrast, though in all cities they are generally sited nearer the node than any other type. Fur specialty shops, however, tend to be dispersed through the periphery of the main concentration.[13]

Footwear stores approach closer to the node even than women's clothing stores (Fig. 8), for there is perhaps more window shopping done in women's shoes than in any other class of retail trade.[14] In the three smaller cities, most outlets are family shoe stores, while in Brisbane women's shoe outlets are as numerous as family stores; yet in all these cities, footwear stores whatever

[13] *Cf.*, Ratcliff: *op. cit.*, p. 55. Nowhere in the capital cities is there any tendency for fur specialty shops to concentrate, nor is there any associations with furniture stores, as was found by Ratcliff. Unfortunately, space does not permit any subsequent comparison in this article of the present findings with those of Ratcliff.

[14] Ellis E. Somake and Rolf Hellberg: *Shops and Stores Today: their design planning and organisation* (London, 1956), p. 69.

their kind jostle with women's clothing stores for the choicest sites. In the million city, while the outlets for women's footwear remain highly centralized, family stores become scattered through the margins of the women's retail area, and men's stores are so widely dispersed as to rank as a secondary element. In general, the number of specialist men's or women's outlets increases with increasing city size, but the number of family stores is much the same in all cities.

Theaters show a strong tendency to cluster among the women's stores, partly because many women combine an afternoon show with a shopping expedition, and partly because this area provides the best "atmosphere" for an evening downtown. Melbourne's pattern is particularly significant, for a distinctive theater cluster is discernible in each of the women's shopping areas. In the four smaller CBDs the number of theaters would seem to confirm the tendency for central areas to become less important for cinema entertainment as cities develop. But this tendency is reversed in the million cities, for there the central theaters exhibit new films for short seasons before their general release and so do not compete in the same way with suburban theaters. The live theater may be isolated among offices, as in Sydney, for it is much more dependent on advance booking. At the other extreme, news theaters occur either among the women's stores or near the main traffic terminals.

SECONDARY INNER RETAIL ELEMENTS

The major secondary elements of the inner retail zone, in sequence outward

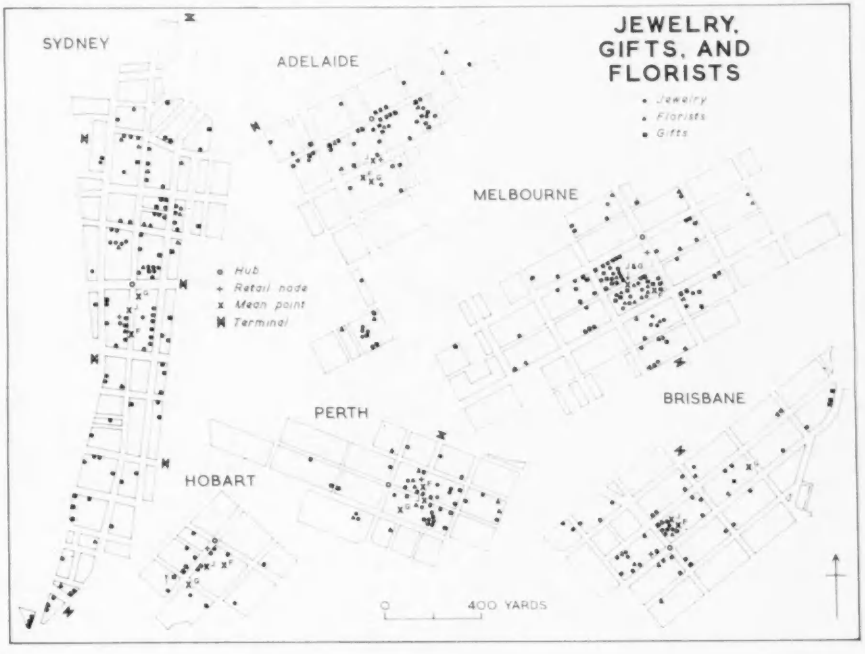

FIG. 9.

from the node, are jewelers, florists, chemists, food stores, coffee lounges, men's clothiers, and gift stores. Of these, jewelry stores tend to be the most strongly nucleated, followed closely by food and then men's clothing stores; chemists are the most widespread. Minor elements include camera stores, outlets for dress materials, beauty parlors, photo studios, wine saloons, and art and music stores. All these secondary elements characterize both the inner and outer retail zones but predominate in the inner. In addition, there are the secondary elements that predominate in the outer zone and will be discussed later.

Jewelry stores show a fairly close association with women's clothing stores, even though their slow rate of stock turn generally precludes them from the best sites (Fig. 9). Nevertheless, as their number grows with increasing CBD size, their distribution changes. In Perth and Hobart both types of store intermingle, but in Adelaide, and markedly so in Brisbane and Melbourne, jewelry outlets tend to be scattered through the fringes of the women's shopping district. In Sydney they are so widely dispersed that the double nuclei of the women's stores are no longer readily apparent. Nevertheless, in all cities, irrespective of the general scatter, the higher-grade stores tend to cluster in a single street—Castlereagh in Sydney, Bourke in Melbourne, Adelaide in Brisbane, Rundle in Adelaide, Hay in Perth. Yet none is comparable to London's Bond Street, perhaps because the demand for real jewelry developed much later than in England and at a time when the specialist retailer was being challenged by department, variety, and fancy goods stores. Even chemists now dispense jewelry!

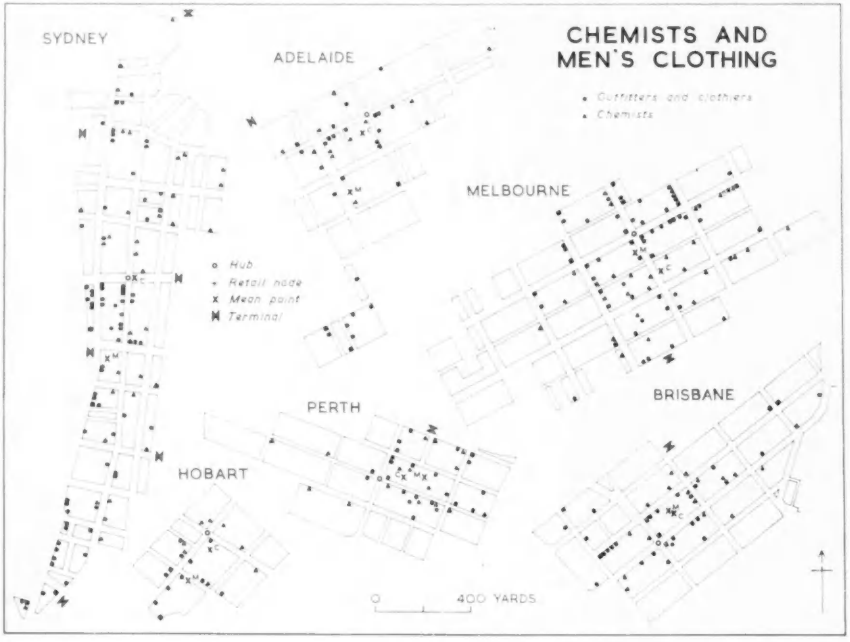

FIG. 10.

Florists show little tendency to change in distribution as the CBD evolves. Perth, Adelaide, and Brisbane have about the same number each, and the million cities twice as many. In all cities florists are either dispersed among jewelry stores or, less typically, along station approaches. In Melbourne, however, no less than a third occur in the main block of specialty stores.

The Australian chemist more closely resembles his English counterpart than the American drug store, for he neither provides refreshment nor retails liquor. But although Australian chemists sell a wide range of articles other than drugs and medicines, they cannot be compared with the large English chemist either in scale or function, perhaps because multiple shop retailing is less advanced in the chemist's trade in Australia. In so far as chemists sell cosmetics, toilet preparations, photographic articles (plus service), handbags, toys, and costume jewelry, they tend to be tied to women's clothing stores (Fig. 10). But typically chemists are dispersed along main pedestrian routes, so that although they predominate in the inner zone, they also occur in the outer zone, especially where this embraces the station approaches, as in Perth. Certain streets may also cater primarily for office workers—Hunter in Sydney, Queen in Brisbane, King William in Adelaide. Although chemists become more numerous with increasing city size, Sydney has only three times the number in Hobart. Unlike the American drug store, chemists do not commonly occur on corner sites.

Food stores are strongly localized between the women's shopping area and the traffic terminals. Many shoppers find it convenient to buy unstandardized foods toward the end of a shopping expedition downtown, so that there are few inner retail blocks without food stores. Yet the evidence from the four smaller cities suggests that there is a tendency for food stores to leave the center as the city grows, though in the million cities this is more than countered by the development of food specialty stores and the increased opportunities for sites within the blocks more suited to their rent-paying abilities. Of the individual types of food store shown in Figure 11, only cake shops, greengrocers, and delicatessens are major elements, and since greengrocers and delicatessens tend to locate near terminals, they are in fact secondary elements of the outer zones. The rest are minor secondary inner elements, being typically found in arcades and side streets. Confectioners are closely associated with the theater districts.

Men's clothing stores occur characteristically on main-street sites marginal to the inner zone. Although in the four smaller cities their number increases but slowly with increasing size of CBD, in the million cities they proliferate. At the same time, they show an increasing tendency to segregate, though the resultant patterns may be either linear, as along the parallel streets bounding the inner districts of Melbourne and Perth, or clusters, as southwest of the hub in Sydney and Hobart. Men's clothing stores are also localized along the main pedestrian routes leading from the office zones, since display is an important factor in sales.

PRIMARY OUTER RETAIL ELEMENTS

The outer retail elements may be distinguished from the inner elements in that they gain little from impulse buying and, especially, in the case of the three major primary elements, require a substantial floor space for display and storage. These three elements are furniture stores, hardware stores,

FIG. 11.

and automobile showrooms. In the three larger cities, furniture stores approach nearest to the node, and in the three smaller, hardware stores; in all cities, automobile showrooms rank third (Fig. 12). Most of the minor elements resemble automobile showrooms in that, being essentially peripheral to the CBD, they are more numerous in adjoining or near-by retail areas. They include retailers of specialist apparatus, motor accessories, motorcycles, and bicycles, parking stations, nurserymen, and even bookmakers. Of these, only the outlets for specialist apparatus are largely confined to the CBD.

Since furniture is normally bought on special shopping expeditions, furniture stores benefit from clustering. In Sydney the main cluster lies south of the node, well within the CBD, while in Melbourne it lies northeast of the node and nearer the periphery. But in Brisbane most stores are far outside the CBD in the Valley or South Brisbane; in Adelaide many are situated just beyond the CBD; and in Perth several occur immediately north of the railway. The marked concentration in Hobart's CBD reflects in part the higher proportion of furniture shopping in Hobart still done at the core. In fact, furniture stores decline in number with increasing CBD size, but become numerous once more in the million city.

On the other hand, hardware stores show a slight gain in numbers with increasing city size, perhaps because of Australian social habits and the large selective demand for tools and other ironmongery. In Brisbane and Perth, and markedly so in Hobart, hardware stores even occur within 50 yards of the hub. In the million cities they lie much

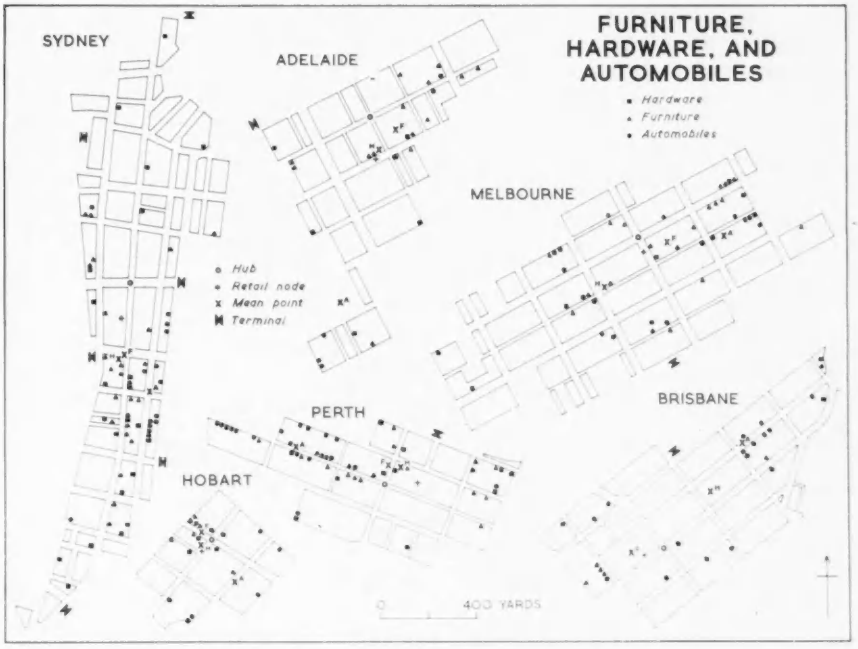

FIG. 12.

farther out, but it is symptomatic that in recent years one large Sydney establishment has moved successfully from the northern margins of the CBD to within 300 yards of the node.

Hardware, like furniture, is usually bought on special shopping expeditions, so that their outlets tend to show similar distributions. In Sydney the correspondence is particularly strong, for one-half of both types of store have congregated around the Pitt-Bathurst intersection. But, significantly, Sydney also has some important hardware stores in George Street, where they cater especially for lunch-time purchases by office workers. In Melbourne the distributions of furniture and hardware stores again coincide; but whereas the nucleus of the furniture outlets lies, as in Sydney, in the main shopping street on the opposite side of the node from the office zone, most of the hardware stores are oriented toward the offices. In all cities an occasional hardware store even outcrops among the office buildings.

Although automobile showrooms are mainly located outside the CBD and are "rare enough to be absent or essentially so" from the American CBD,[15] they are nevertheless present in all the CBDs of the capital cities of Australia in numbers bearing some general relationship to CBD size. They also show a high degree of cluster, and occupy fairly comparable locations on the periphery, usually of the outer retail zone. On the other hand, commercial parking, "apparently typical" of the

[15] Raymond E. Murphy and J. E. Vance, Jr.: "A Comparative Study of Nine Central Business Districts," *Econ. Geog.*, Vol. 30, 1954, pp. 301–336; ref. on p. 334.

American CBD, occurs only within the CBDs of Melbourne and Sydney. It might perhaps be added, however, that the center of gravity of auto sales establishments within the CBD is farther from the node than is that of any other major element.

SECONDARY OUTER RETAIL ELEMENTS

Both the inner and outer retail zones have, on the whole twice as many secondary as primary units. However, in its secondary land-use the outer zone has fewer major but more minor elements, though in the number of units representing the major and minor elements respectively it has only one-third those of the inner zone. The major secondary elements tend to follow the outward sequence of shoe repair depots, milk bars, outlets for electrical goods, cafés, and stationers, but departures from the norm are more numerous and more substantial than in the case of the inner retail elements. Two minor elements—service stations and auction rooms—occur to a lesser extent in the office district. Those minor elements characterizing both the inner and outer zones but predominating in the outer include optometrists as well as stores selling sports goods, floor coverings, furnishings, antiques, leather goods, toys, records, sewing machines, and army disposals. The outer zone also contains the secondary elements that predominate in the inner areas and have already been discussed.

Eating places present a fairly even scatter through the CBD, though the pattern is broken in all cities by the financial office core and, in the million cities, by sections of the main shopping street adjoining the hub (Fig. 13). In

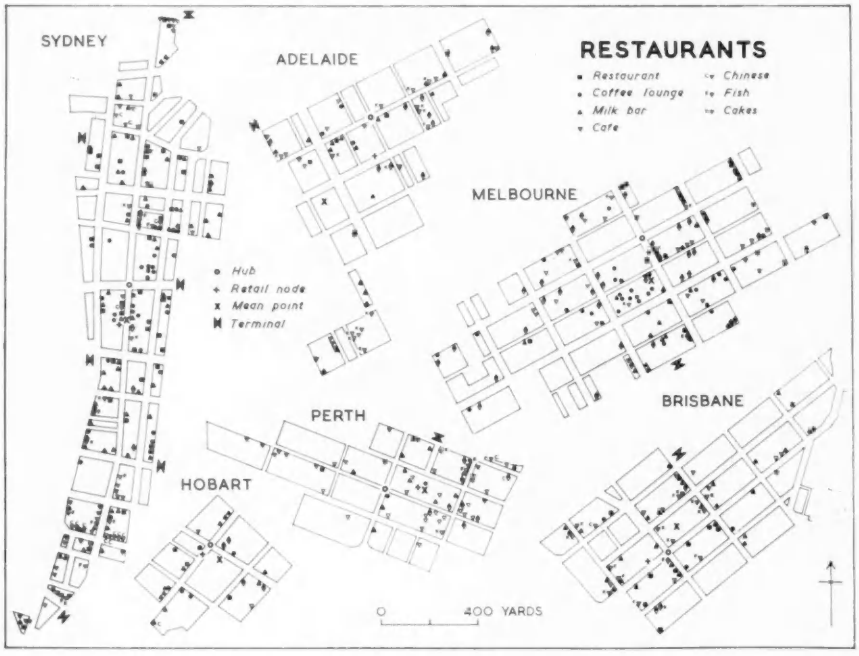

FIG. 13.

general, cafés retailing cakes, or in Melbourne and Sydney small tea and coffee lounges, intermingle with women's clothing stores and restaurants with theaters, while farther out they are replaced by milk bars and toward the margins milk bars yield place to low-grade cafés and dining rooms. Nevertheless, there is a tendency for services to congregate in areas transitional between the inner and outer zones, particularly along pedestrian routes to the stations.

The total number of eating places may be broadly related to city size, though each city is somewhat distinctive in the predominant types of service provided. Cafés retailing cakes are the only service present in similar numbers in all cities, while coffee lounges are virtually peculiar to the million cities. Sydney has substantially more eating places than Melbourne, but this is partly attributable to the inclusion within the CBD of the southern zone of discard with its Chinese cafés and even cafés retailing fish. Such areas are mostly outside the CBD in the other cities.

Stores retailing radio and electrical goods are the only secondary outer element with a strong tendency to cluster (Fig. 14). However, they fall into two fairly distinct but overlapping groups, each with its own nucleus, and if it were possible to exclude the groups by their sales, each would constitute a significant major element. Thus small stores specializing in such appliances as toasters, lamps, heaters, and radios occur closely associated with men's clothing stores on the margins of the inner zone; they would constitute a secondary inner element. Larger stores specializing in such lines as washing machines, refrigerators, cookers, and radiograms are closely associated with furniture stores which they resemble in function; they would constitute a primary outer element. Since the total number of both types within the CBD in Perth, Adelaide, and Brisbane declines with increasing city size, they would seem to be excluded from the district as the CBD develops. Melbourne has slightly more outlets than Perth, and Sydney considerably fewer. The small stores of the inner zone are present in similar numbers in all cities.

Stationers carry a wide range of stock and have a slow rate of stock turn, so that with an expanding CBD they tend to move outward from the node. In Hobart and Perth the majority are situated within the inner zone, but in the larger cities other than Melbourne they lie mainly in the outer zone and in Melbourne mostly among offices. Many stationers, particularly the specialist card shops which are a feature of the million cities only, are combined with printing works not far from the CBD. The number of specialist stationers bears little relationship to city size, partly perhaps because stationery, like many other commodities, is spread over numerous heterogeneous outlets, ranging from department stores to small bookshops and even chemists. City stationers differ from their suburban counterparts in that few handle newspapers; these are mainly sold from kiosks, stalls, and especially street vendors.

THE OFFICE ZONE

Offices are generally less sensitive to location than retail outlets, and since they reveal a very much greater vertical development, several functions here classified as minor elements in the ground-floor structure assume great importance on upper floors. The only major primary elements are the offices of insurance companies, shipping firms, and the professions (Fig. 15), though minor primary elements include headquarter offices, stock and station agents,

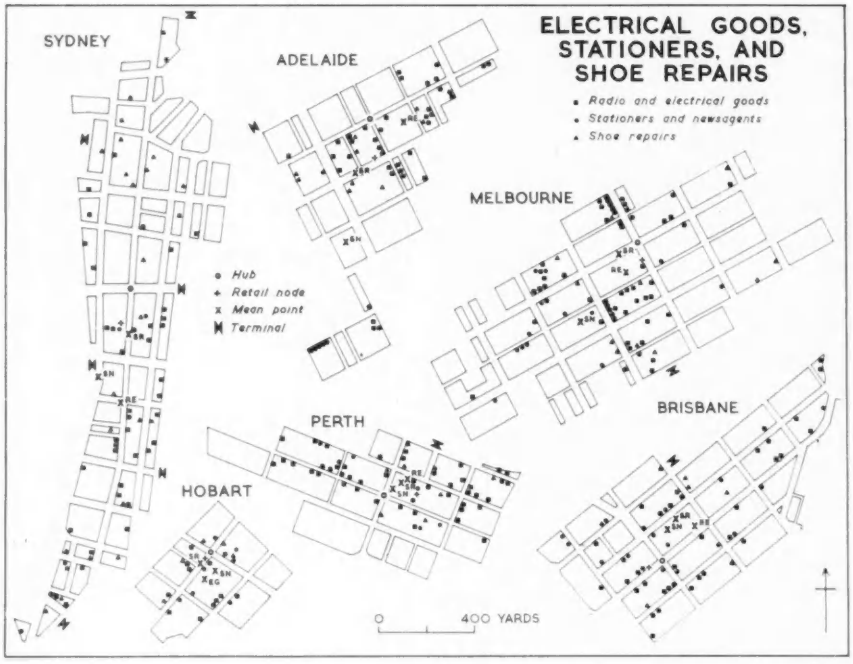

FIG. 14.

airline offices, stock and share brokers, and accountants. Moreover, the only major secondary element is clubs and societies, which overlap into the outer retail zone. Other overlapping secondary elements, all of them minor, are outlets for office equipment, real estate agencies, travel agencies, and newspaper publishing.

Insurance companies own many of the larger office buildings in the capital cities, and while they usually occupy the ground floors themselves, other headquarter offices, solicitors, accountants, estate agents, sharebrokers, architects, and a host of other tenants share the upper floors. One such twelve-story building in Melbourne, where the ground floor is used by an insurance company, a bank, and a government agency, has 170 such tenants above street level. Although these insurance buildings are quite low by American standards, they nevertheless present an impressive concentration. Moreover, it is mainly among the insurance buildings that the intense redevelopment of the past decade has taken place. Accordingly, as the old height limits in the million cities are relaxed to permit buildings of 200 feet or more, and as parts of the sites are left open to compensate for the greater building height, new glass-fronted towers are beginning to break up the sombre cliff-like masonry of the city streets. These developments lie at the very core of the office zone. They are separated from the inner retail zone by a buffer area in which outer retail or marginal office elements predominate on the ground floor with offices or, nearer the node, service trades and workrooms above.

Shipping offices lie farther from the

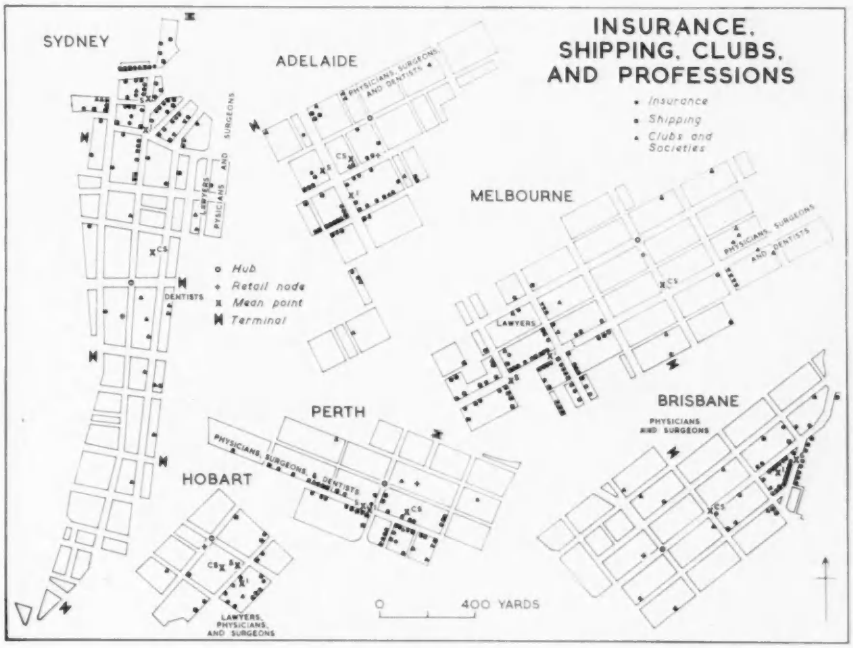

FIG. 15.

node than insurance offices in all the cities save Hobart. Since they tend to cluster on the outer margins of the office zone, a number fall outside the CBD boundaries. The isolated occurrences nearer the hub function primarily as travel agencies.

Professional offices are largely independent of the pull of central business, so that their location relative to the hub varies more from city to city than does that of any other type of office use. Lawyers, particularly barristers, tend to cluster near the courts, while physicians, surgeons, and dentists occupy chambers either in modern office blocks, as predominantly in Melbourne, Adelaide, and Perth, or in fashionable nineteenth-century residences, as predominantly in the other cities. In Brisbane and Hobart these concentrations fall outside the CBD, while in Adelaide doctors would seem to be moving out to the fashionable residential area of North Adelaide.[16]

City clubs for professional and businessmen tend to cluster near professional offices on the fringes of the office zone, for they too seek sites in congenial settings. Some clubs, particularly those standing in extensive grounds, are even outside the CBD. Those located nearer the hub are chiefly the smaller organizations of New Australians.

DISPERSED ELEMENTS

Almost all the dispersed elements predominate in the outer retail zone, and are more numerous in the inner zone than in the office quarter. They include hotels, booksellers, restaurants,

[16] *Cf.*, Walter Firey: *Land Use in Central Boston* (Cambridge, Mass., 1947), pp. 279–283.

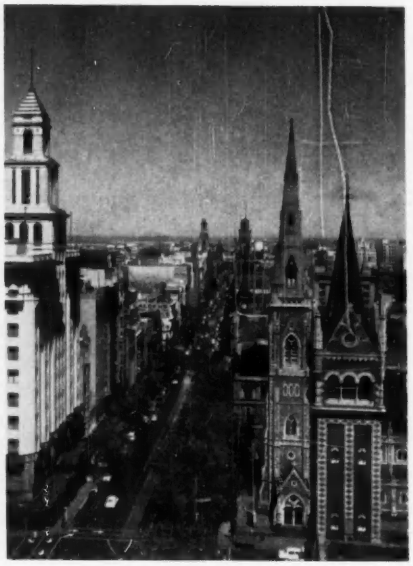

FIG. 16 (left). Martin Place, Sydney, viewed eastward from George Street. Martin Place and Park Street are the two widest streets in Central Sydney, both being 100 feet wide. Like Goulburn and Elizabeth, which are 90 feet, they have been widened at great expense. Other Sydney streets are mainly 60 feet wide. Since their widening, Martin Place, Park Street and Goulburn Street have become increasingly significant as breaks between the office, inner retail, and outer retail zones. The 40,000 young women employed in the office buildings of Martin Place are an important factor in maintaining the stability of the inner retail zone immediately to the south. At the eastern end of Martin Place is the Sydney Hospital. (Photograph by courtesy of the Australian News and Information Bureau.)

FIG. 17 (right). Collins Street, Melbourne, viewed southwestward from Russell Street. From Russell to Swanston, the next intersection, Collins Street slopes downhill. On the south side are high-grade women's stores on the ground floor with professional offices above, while on the north side, beyond Scots Church seen in the foreground, is Georges, Australia's only department store catering exclusively for the wealthy. Beyond Swanston is a zone of medium-grade inner retail stores and business offices, then an outer retail and business office zone, then a concentration of headquarter banks, and finally, beyond Queen Street, a concentration of insurance offices. Tree-lined Collins Street is probably the finest street in Australia, and one of the finest in the world. (Photograph by courtesy of the Australian News and Information Bureau.)

tobacconists, tailors, receiving depots for dry cleaning, and barbers. However, banks predominate in the office quarter, and are generally more numerous in the outer retail zone than in the inner. In the number of units present, hotels, and to a lesser extent banks and barbers, are directly related to city size, while tobacconists are more closely related to CBD area. On the other hand, book stores, restaurants, and tailors vary greatly in number irrespective of city size, and dry cleaners tend to decline as the CBD develops. Nevertheless, all are major units.

Of the many CBD elements hotels are the most widely and the most evenly spread (Fig. 18). Some cater primarily for short-stay visitors, but since Australians are rather fond of their beer, most depend largely on their bar trade. Corner locations are thus the most favored, accounting for no less than three-quarters of the hotels in Sydney and about one-half in each of the other cities. Even a century ago, a public

house on each corner was stated to be "generally the case in Sydney."[17] Today, King Street, which for the most part runs between the office and retail zones, has the greatest density with hotels on no less than ten of its twenty corners. In at least their location, therefore, hotels would seem to be the Australian equivalent to the American drug store.

Tobacconists (shown in Figure 18) are mainly specialists devoted exclusively to the sale of cigarettes, cigars, and tobacco. Their distribution, though generally dispersed, is far from uniform, partly owing to the tendency for tobacconists to locate near men's clothing stores and offices, and partly owing to the fact that the competition of non-specialist outlets varies with location and with CBD area. In the four smaller cities the number of specialist retailers in the inner zone increases with increasing city size, though they remain few in the office zone. In the million cities, however, the high rents near the node preclude the specialist and favor the kiosk, so that Sydney's central shopping block, for instance, has seven kiosks and not a single specialist; but in the office zone specialists abound. In all cities the number of tobacconists in the outer retail zone may be broadly related to CBD size.

Barbers, in contrast to women's hairdressing establishments, rank as a major element, for they rarely succeed above ground level. They are almost as numerous in the office zone as in the inner zone, and show a stronger tendency than tobacconists to locate near men's clothing stores and offices.

Banks are the most numerous of all the dispersed elements, though they

[17] Joseph Fowles: *Sydney in 1848* (Sydney, 1848), p. 81.

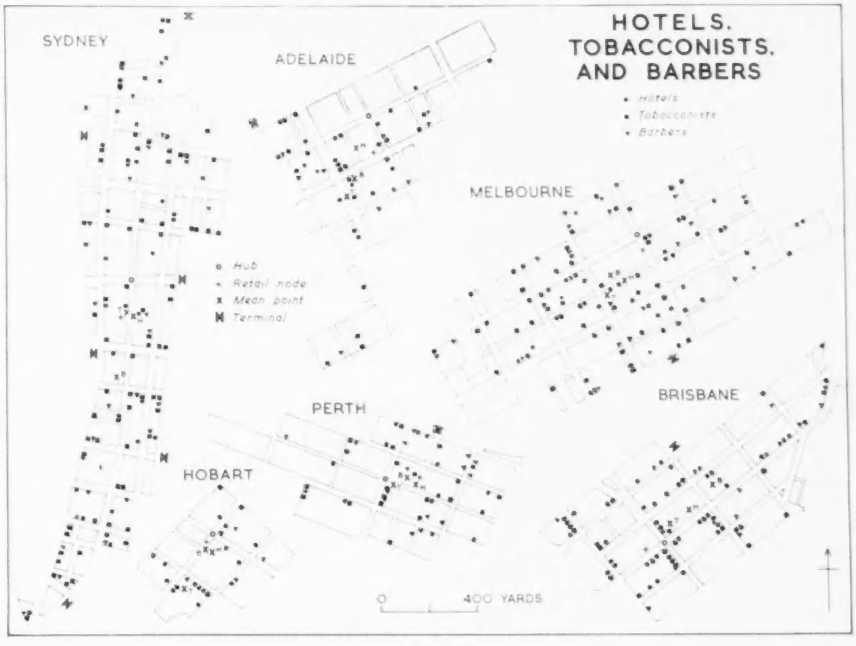

FIG. 18.

tend to become less evenly spread as the CBD develops (Fig. 19). In Hobart and Perth, by contrast with the other cities, banks are more numerous in the outer retail zone than in either of the other two zones, and occupy more corner sites than even hotels do. In fact, they tend especially to seek sites on intersections in the main shopping street, markedly so in Hobart where they occupy six out of eight corners, including those of the hub. In the larger cities, particularly in Melbourne and Sydney, banks tend to become increasingly more numerous in the inner retail than in the outer zone, while strong concentrations of headquarter banks are evident in the office quarter, notably in Collins Street, Melbourne, and to a lesser extent in George Street, Sydney.

In all the capital cities, book stores are characteristically dispersed through the inner margins of the outer retail zone, overlapping into the inner zone. In general, the pattern tends to be circular, even in Melbourne where there are ten book stores on or near the west side of Elizabeth Street. Almost all the booksellers have sought to maximize their returns by encroaching on other trades, notably by selling stationery and fancy goods but also pictures and records; several are essentially compound businesses. In the office zone booksellers specialize chiefly in medical or law books; the medical book stores also carry hospital appliances and surgical instruments, and a science bookshop handles microscopes. Political bookshops are absent, and only Melbourne has a foreign language bookshop. But by far the most numerous of the specialists are the religious bookshops,

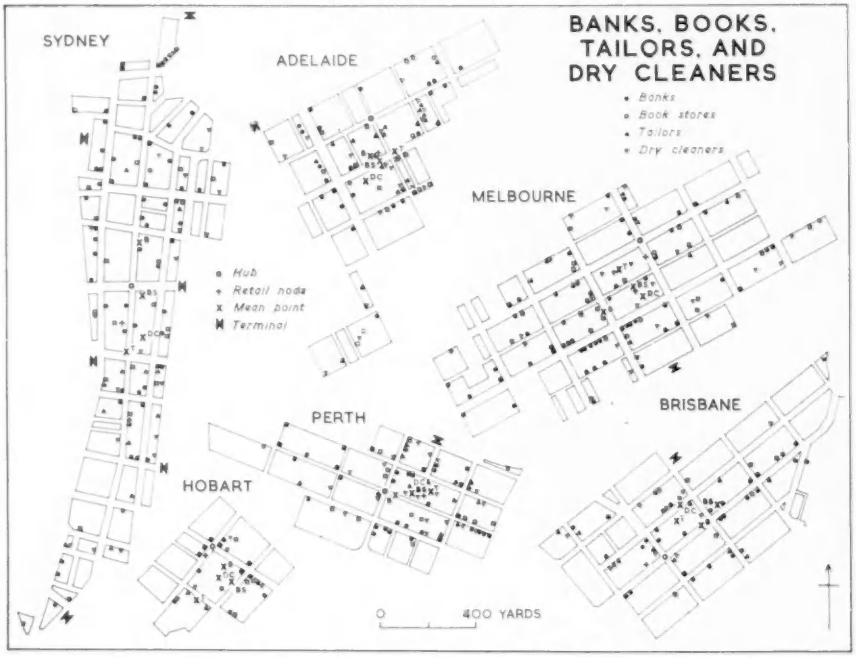

FIG. 19.

particularly Catholic ones; in all they amount to nearly a quarter of the total outlets. One such retailer in Perth has as close neighbors another specialist retailing "sexology unobtainable elsewhere" and the Perth Literary Institute. Booksellers would seem to be, as Samuel Johnson remarked, "generous liberal-minded men."

Tailors only just qualify to rank as a major element, since most occupy upper floors and, in any case, the demand for ready-to-wear garments as against bespoke clothes has long been increasing. In the three smaller cities tailors predominate in the inner zone and are more numerous in the outer zone than in the office quarter. In the three larger cities, however, they predominate in the outer zone and are more numerous in the office quarter than in the inner zone.

By contrast, the more numerous dry cleaning depots present for all cities the typical allocation of the dispersed elements among the three structural zones.

THE SMALLER CBD

Many of the above conclusions regarding the central business elements of the Australian state capital cities, such as the increasing specialization of retail elements, their changing associations, their degree of cluster, and their sequence outward from the node, might well assist toward an understanding of the detailed structure of smaller centers. Moreover, such application might in itself establish fairly consistent departures, thereby furthering our knowledge concerning the early stages in the evolution of the Australian CBD. In any event, the basic concepts require continual refinement, especially in view of the ever changing character of retail elements and the growing suburbanization of retail trade.

Freemantle, the twelfth largest Australian town (1954 population: 47,300), may be taken as a random illustration (Fig. 20). Its CBD is too small and too near Perth to support even a single department store, and only the four blocks adjoining the hub would qualify as central business by the index method of Murphy and Vance. Four of the five footwear stores cater for families, and only one exclusively for women; yet they generally nestle closer to the hub than the women's clothing stores, all of which offer the full range of women's wear. The sequence of secondary inner elements, as determined by their mean points in relation to the hub, is disturbed by food stores, which significantly are the most numerous of any type of retail outlet, and by men's clothing stores; yet both these elements present distinct and meaningful patterns. Of the three primary outer elements, hardware stores, as in the three smaller capital cities, approach nearest to the hub, followed by furniture stores and auto sales. The secondary outer elements of restaurants, retailers of electrical goods, and stationers likewise conform to the established sequence. Offices are few; but professional offices cluster to the northeast, shipping offices cluster farther away near the docks, and real estate offices fringe the main shopping area. Hotels are naturally oriented westward toward the docks, while banks exhibit a centrality and nucleation reminiscent of Hobart; both elements are mainly associated with the outer retail quarter. There is no specialist tobacconist, no store retailing office equipment, and only one book store. In short, despite the great intermingling of elements, their character and arrangement suggest the rudiments of the Australian CBD.

It is probable that in towns smaller than Freemantle the distributions of the outer retail elements may overlap those of the inner retail elements to a very marked degree, and that the se-

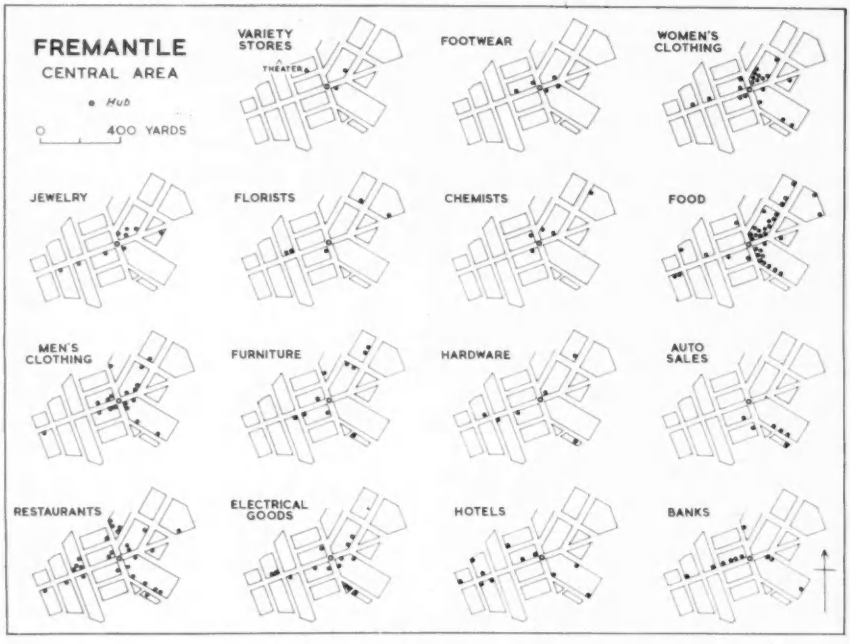

FIG. 20.

quence outward from the node, particularly perhaps of the outer elements, may reveal many departures from the norm. Yet in many smaller towns in Australia the CBD is a single street; and here the inner retail elements tend to be concentrated on one side, the outer elements on the other, and the dispersed elements to be distributed between the two. This holds true even for a center as small as that of Burnie, Tasmania's third largest town (1954 population: 11,200). Most of the central business in Burnie is confined to Wilson Street between two adjacent cross streets. Although the outer elements on the east side conform but little to the sequence presented in this paper, the inner elements on the west side are patterned with striking consistency about the single variety store that marks the point of maximum pedestrian flow. But in so far as the character, associations, and arrangement of the various land-use elements in the main street of Burnie, or of any other Australian town, depart from the general structure and evolution of the Australian CBD, lies one geographical measure at least of its immaturity or individuality.

SMALL-SCALE LAND USE MAPPING FROM STATISTICAL DATA

Charles N. Forward and Charles W. Raymond

Dr. Forward and Mr. Raymond are on the staff of the Geographical Branch, Department of Mines and Technical Surveys, Ottawa, Canada. This article is based on research conducted at the Geographical Branch in 1958. In October, 1959, Dr. Forward will join the staff of Victoria College, Victoria, B. C., as Lecturer in Geography.

THE program of land use mapping in accordance with the world land use classification has proceeded very slowly in Canada. Field mapping and interpretation of aerial photographs have been carried out in limited areas, particularly in the Atlantic Provinces. The map scales employed with these methods have ranged chiefly from 1:15,000 to 1:63,360. Few attempts have been made to produce land use maps of broad areas at the 1:1,000,000 scale because the more detailed mapping used as the basis is spotty in distribution. Without a new approach to the problem many years will pass before the small-scale map exists.

In an effort to produce a valid land use map at the 1:1,000,000 scale in a short period of time a method has been devised to utilize essentially statistical data, thereby avoiding the time-consuming tasks of field mapping, aerial photograph interpretation, and generalization from the photograph scale of about 1:15,000 to the final scale of 1:1,000,000. Nevertheless, the more detailed field mapping for publication at scales larger than 1:1,000,000 is continuing.

Reduction of Map Scale

A land use map at the million scale is far removed from the reality of the earth's surface it represents. One mile on the earth's surface is about $\frac{1}{16}$ inch on the map. There may be a great variety of uses apparent within a square mile of farm land, but this square mile must be represented by a small square measuring $\frac{1}{16}$ inch along its sides. Unless the land use is remarkably uniform over many square miles, a great deal of generalization is necessary. In a land of mixed farming and dairying such as Southern Ontario there may be half a dozen farms each growing a variety of crops within a square mile.

By means of a process of generalization the various land uses can be shown on a small-scale map, but great difficulties are encountered in maintaining the areal ratio of land uses as they exist in reality (Fig. 1). Generalization by eye from a detailed land use map (2 inches to 1 mile) to the desired small scale introduces inaccuracies in the representation. The areas of each land use category ought to be known in order to generalize intelligently. These areas could be obtained with a small margin of error by using a planimeter or a sampling technique. Knowing the area of each category, the cartographer would amalgamate small units to form large units that could be shown on the million map. These large units would be placed on the million map at the

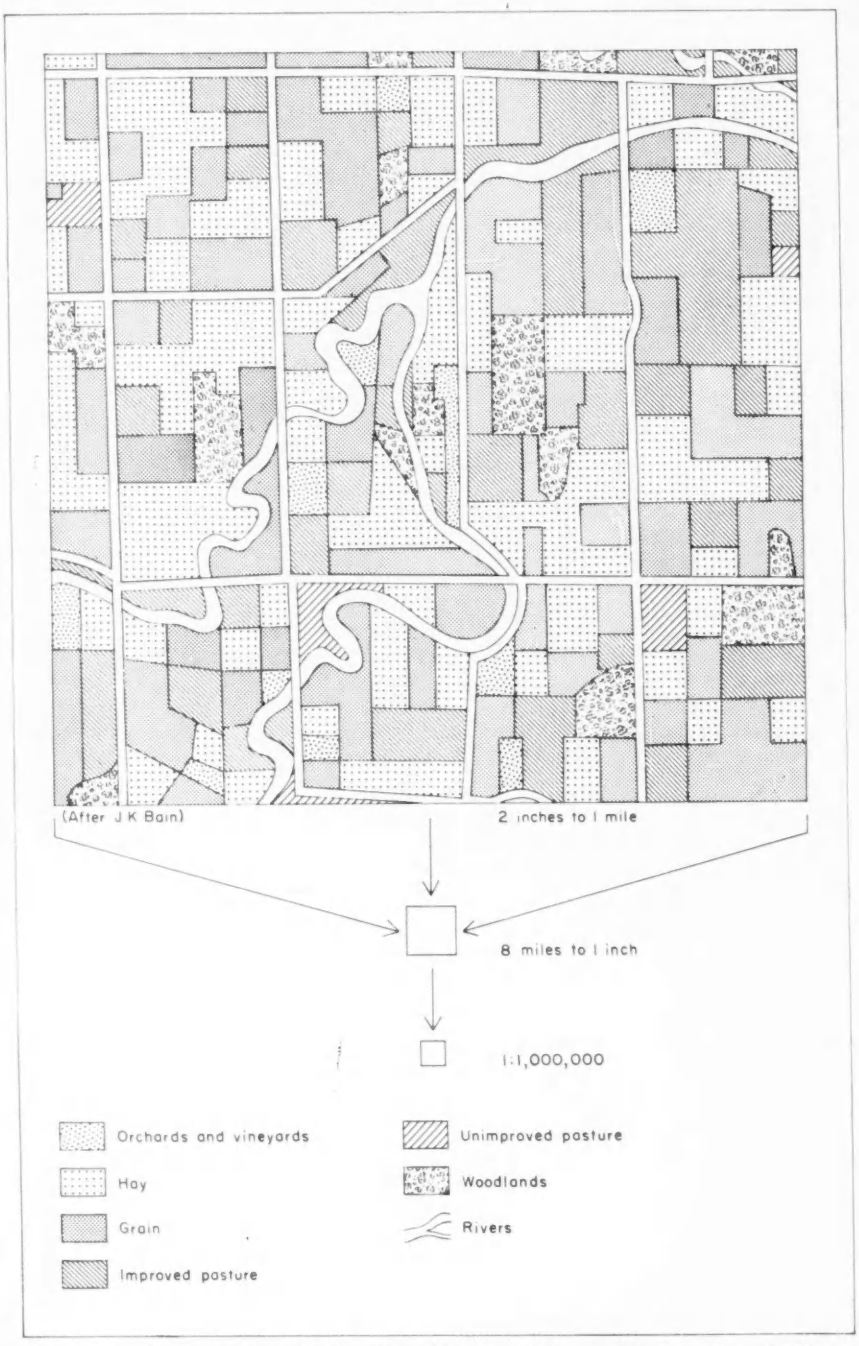

FIG. 1. Southeastern corner of Clinton Township, Lincoln County, Ontario. A graphic illustration of the problem of reducing a large-scale land use map to 8-mile or "million" scales.

centers of gravity of the dispersed small units they represent. This laborious procedure begins only after detailed land use mapping has been completed. The use of statistical data from the beginning achieves a similar result with little effort.

THE STATISTICAL BASIS FOR LAND USE MAPPING

The Canadian Census of Agriculture, 1956, provides recent data on acreages of crops and other land uses for relatively small divisions. In Southern Ontario these divisions are the townships, ranging in size from approximately 25,000 acres to 75,000 acres, the average being about 40,000 acres. The crop acreages given in the census have been adapted to a workable legend for the land use map (Table I).

The land use categories conform essentially to those of the World Land Use classification, except in the case of woodlands. In fact, the cropland category of the world system has been subdivided into grain, hay, tobacco, and soybeans to provide further significant detail. As rotation cropping is common throughout the area and as the statistics do not indicate cropping methods, the World Land Use rotation categories are omitted. All woodlands have been placed in a single category because it is impossible to determine sub-types from the statistical data.

The choice of map scale on which the land use is plotted depends fundamentally on the size of the statistical units used. It is felt that the townships of Ontario permit plotting with accuracy

TABLE I

LEGEND FOR SOUTHERN ONTARIO LAND USE MAP

Land use categories	*Color*	*Headings in the 1956 census of Canada included in each category*
1. Settlements and Associated Non-agricultural Land	(red)	
2. Horticulture	(violet)	(potatoes, vegetables, *sugar beets, turnips, nursery products, strawberries* and *raspberries*)[a]
3. Orchards and Vineyards	(lavender)	(*tree fruits* and *other small fruits*)
4. Hay	(dark brown)	(tame hay, *buckwheat*, and other fodder crops)
5. Grain	(orange)	(wheat, oats, barley, rye, flax, mixed grains, corn for ensilage, and *corn for grain*)
6. Tobacco	(burnt ochre)	(*tobacco*)
7. Soybeans and Peas	(sand)	(*soybeans, field beans, field peas* and *other field crops*)
8. Improved Pasture	(light green)	(pasture and summer fallow)
9. Unimproved Pasture	(lemon yellow)	(not listed in the census; therefore, assumed to include 50 per cent of "other unimproved land" plus 35 per cent of "other improved land")[b]
10. Woodlands	(grass green)	
11. Swamps and Marshes	(olive green)	
12. Unproductive Land	(light gray)	

[a] The items in italics were not published on a township basis and had to be obtained in manuscript form from the Dominion Bureau of Statistics.

[b] The remaining 50 per cent of "other unimproved" is considered to fall in the "woodland" and "swamp" categories of the legend and the remaining 65 per cent of "other improved" is considered to fall in the "settlement" category.

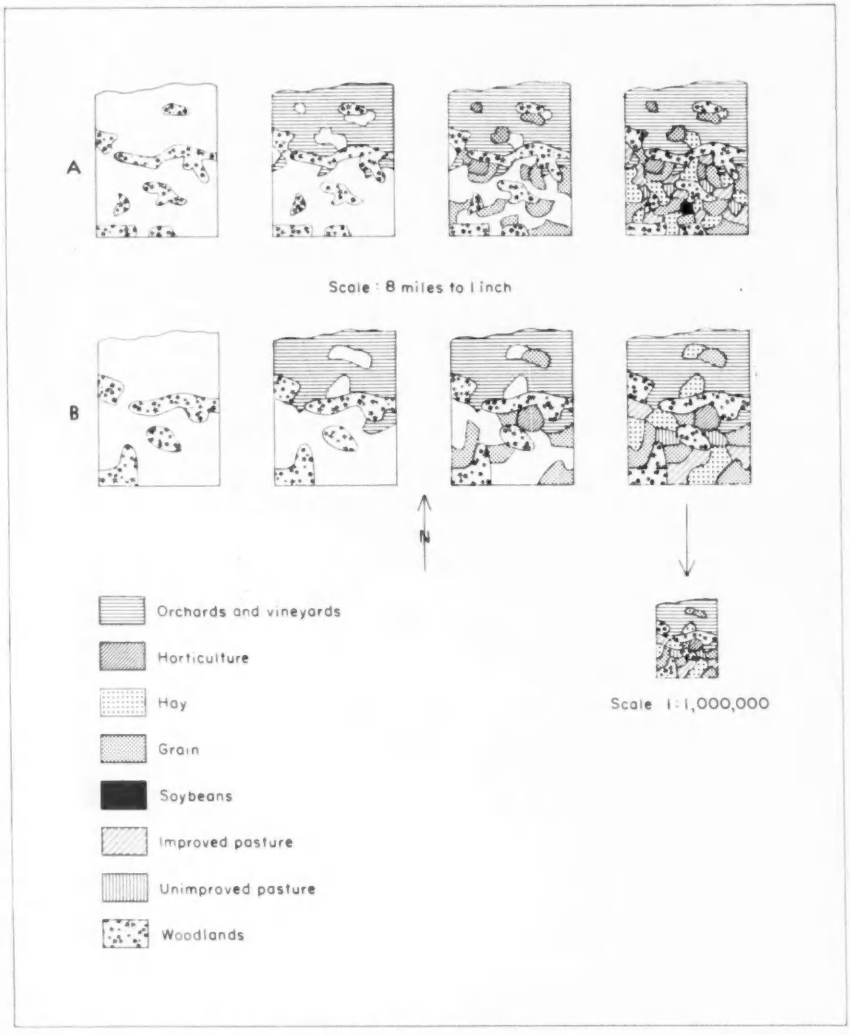

FIG. 2. Clinton Township, situated in Lincoln County, Ontario. Successive stages in the plotting of land use for reproduction on the 8-mile scale (A) and further generalized for reproduction on the million scale (B).

at scales of 8 miles to 1 inch or smaller. Two maps of Southern Ontario, both on 8-mile bases are being produced. One was designed for reproduction on the 8-mile scale and the other was designed for photographic reduction to the million scale. In consultation with the map draftsmen and printers the minimum size of unit for reproduction was determined. On the 8-mile scale the minimum size of unit adopted was $\frac{1}{16}$ inch squared (160 acres), while on the million scale the minimum size was $\frac{1}{8}$ inch squared (640 acres).

PLOTTING TECHNIQUE

Plotting of land use begins with the woodland and urban categories. Wooded areas are shown on map sheets at 1:50,000 and 1:250,000 scales, but not on the 8-mile scale. Therefore, the wooded areas on the 4-mile sheets are checked for accuracy against the 1:50,000 sheets and generalized. Then they are transferred to the 8-mile scale by the use of a Saltzman projector (Fig. 2). The generalization is greater for the million map than for the 8-mile map. Similarly, urban and associated non-agricultural land is transferred, using recent 1:50,000 sheets and city maps as guides in determining the limits of built-up areas. The remaining space within each township is apportioned to the other land uses on the basis of acreage.

Measurements are carried out with squared paper (K and E – 16x16 – 358–9) on which one square represents 160 acres on the 8-mile map. As a check on the accuracy of the acreage figures the whole township is measured with the squared paper, as well as the area of wooded and urban land. All land uses combined should total the area of the township. If not, a search for further data on wooded and urban land and a check of previous census figures generally indicates the reason for the discrepancy and where a correction should be applied. The acreages of the land use categories are converted to minimum-sized units for easy plotting by dividing by 160 acres (Table II).

In Clinton Township it is necessary to plot 132 squares in the open space remaining after wooded and urban land has been established. The distribution of these 132 squares on the map is the decision of the geographer. Every scrap of available information must be used to guide him in this task. If a large-scale land use map is available the plotting is easy, but in most cases such maps are non-existent. The 1:50,000 topographic sheets may be of assistance in showing where farms are located. Soils maps are especially valuable, as the land use on each soil type is usually indicated in general terms. A knowledge of the agricultural practices in an area and the types of soil generally allotted to each use enables the geographer to make a good approximation to the true distribution. The task calls upon the geographer to apply the principles and methods of his geographic training. Actually, the scale at which he works leaves little room for serious error because he deals in units of 160 acres or larger.

TABLE II

CLINTON TOWNSHIP, LINCOLN COUNTY

Land use	*Acres*	*Number of 160 acre squares*
Horticulture	622	4
Orchards and Vineyards	8,572	54
Hay	4,053	25
Grain	3,691	23
Tobacco	0	0
Soybeans	174	1
Improved Pasture	2,879	18
Unimproved Pasture	1,175	7
Total	21,166	132

Although a land use map of Clinton Township was available, several agricultural studies indicate that most of the orchards and vineyards are situated below the Niagara Escarpment along the shore of Lake Ontario. Also, the 1:50,000 topographic sheets show the locations of orchards. After the 54 squares of "orchards and vineyards" have been placed it is relatively easy to plot the remaining uses (Fig. 2). However, surrounding townships should be taken into consideration when plotting land use. The statistical data may indicate a large concentration of a particular crop along a border area of

adjoining townships. Also, an area, say, 80 acres of horticulture, in each of two adjoining townships could be considered as one square to be placed on the border.

The units are not plotted on the map as squares because this would result in an unnatural geometric appearance. The straight-line boundaries of land uses on large-scale maps are often unavoidably lost in generalization to the million or even to the 8-mile scale. The shapes of land use units ought to conform to the shapes of wooded areas, and these are mostly rounded, even on the 4-mile maps. However, occasionally straight lines are desirable to add variety to the shapes of units. The sizes of units should also vary considerably in order to appear natural.

As units are plotted they should be accurately measured with a transparent grid or template to keep a record of the areas added in terms of squares. It is unwise to plot all the squares of each land use type systematically because there may be either too much or not enough space for the last category plotted, owing to errors in measurement. Therefore, only 80 per cent or 90 per cent of each land use type should be plotted at first so that errors in measurement may be distributed among all categories. When the whole township has been completed the boundaries of the colored land use units may be inked for clarity, leaving the units open along the borders of the townships. These will be closed when plotting the land use of adjoining townships, thereby avoiding the appearance of political boundaries on the map.

ADVANTAGES OF THE METHOD

One of the greatest advantages of the method is that the areal representation of each land use category is remarkably accurate because the map is based on the most recent census data. The acreages of various land use types were obtained from the farmers themselves by interview during the 1956 census. The achievement of this accuracy is very difficult by field and aerial photographic recognition of land uses, even ignoring the possible errors that may occur during the process of generalization from large to small scales. Seasonal changes in appearance of crops is a factor that presents difficulties in field mapping programs. Accurate photographic interpretation of land use is even more difficult, owing to confusion of such uses as hay and improved pasture, as well as tone and texture variations of a seasonal nature. Consequently, the use of census data is a valuable check on the accuracy of field or photo mapping.

The method enables not only the production of small-scale land use maps when none are available, but also the reduction of large-scale maps already in existence. Possessing the acreage data from the census, there is no need to measure the areas of each land use category on the large-scale map in order to maintain accurate areal representation. The map is simply constructed by placing known areal units in positions indicated by the large-scale land use map.

The accuracy of the method increases with the use of smaller statistical divisions. Agricultural data for the Canadian census is gathered from enumeration districts, smaller than townships, but unfortunately is not tabulated for these districts.

The rate of land use mapping by the statistical method is very rapid. In a normal day's work one man can start from the blank base map, assemble the data, and complete three or four townships (120,000–160,000 acres approximately) on the generalized million map where the minimum unit is about four squares. The more detailed 8-mile map

where the minimum unit is about one square requires more careful plotting of smaller units and one or two townships (40,000–80,000 acres approximately) per day is the average rate of production.

CONCLUSION

The statistical approach to land use mapping was devised for the purpose of producing small-scale maps of broad areas of Canada in a short period of time. The method is applicable to other areas where suitable and accurate agricultural statistics are available. Its main advantages may be summarized in the following points:

1. The areal representation of land use categories is quite accurate.
2. The mapping of many different crops is facilitated because the statistical data is published by individual crops.
3. The statistical data used is recent and uniform throughout the country at a specific date.
4. Mapping land use at census periods in the past is made possible.
5. Reduction of large-scale land use maps is made easier and more accurate.
6. The rate of production of small-scale land use maps is very rapid.

BOUNDARY STUDY AS A TOOL IN CBD ANALYSIS: AN INTERPRETATION OF CERTAIN ASPECTS OF THE BOUNDARY OF CAPE TOWN'S CENTRAL BUSINESS DISTRICT

D. Hywel Davies

Mr. Davies is senior lecturer in geography in the University of Cape Town. He has been engaged in urban geographical studies of central Cape Town since 1956. This article is concerned with only a small part of a research project in which it is intended to examine many aspects of the city's CBD.

THE nature and structure of Central Business Districts (CBDs), in particular those of American cities, have been the subject of considerable research in recent years within a number of related fields. Urban geographers have played their part in building up a body of knowledge, not only with studies of individual CBDs but also, more recently, with comparative studies. From the latter have been developed certain standardized techniques of delimitation, description, and analysis which have allowed a start to be made on the formulation of academic theories that may, in turn, be applied to the practical problems which now beset the typical CBD.

In this article an attempt is made to interpret some of the more important aspects of the CBD boundary in Cape Town, the legislative capital and one of the two leading ports of the Union of South Africa. It is hoped to show that some of the character and problems of a CBD can be analyzed by the study of its boundary. It is hoped, too, that this approach will be found to have some application to other western CBDs. With this in mind, the delimitation techniques adopted were carefully selected for their applicability to other cities.

The Site and Urban Setting of the CBD[1]

The focal point of commercial activity in Cape Town has not moved in three hundred years. The site of the original settlement of the victualing station established by the Netherlands East India Company in 1652 is today covered by the tall buildings of the CBD.

The CBD occupies the flattest land at the center of the amphitheatre formed by Table Mountain and its eastern and western bastions, Devils Peak and the Lion.[2] On the seaward side it is bordered by railway and dock installations, reclaimed land, industrial establishments, and warehouses; on the other sides by zones transitional to the residential areas which occupy the lower slopes of the amphitheatre up to about 500 feet above sea level.

With the development of mining at Kimberley and along the Witwatersrand in the latter half of the nineteenth century Cape Town grew rapidly, while the establishment of suburban rail services permitted the expression of this growth

[1] For a generalized description of the setting in terms of functional regions, see Peter Scott, "Some Functional Aspects of Cape Town," *Econ. Geog.*, Vol. 30, 1954, pp. 347–363.

[2] *I.e.*, Lions Head plus Signal Hill. See Fig. 2.

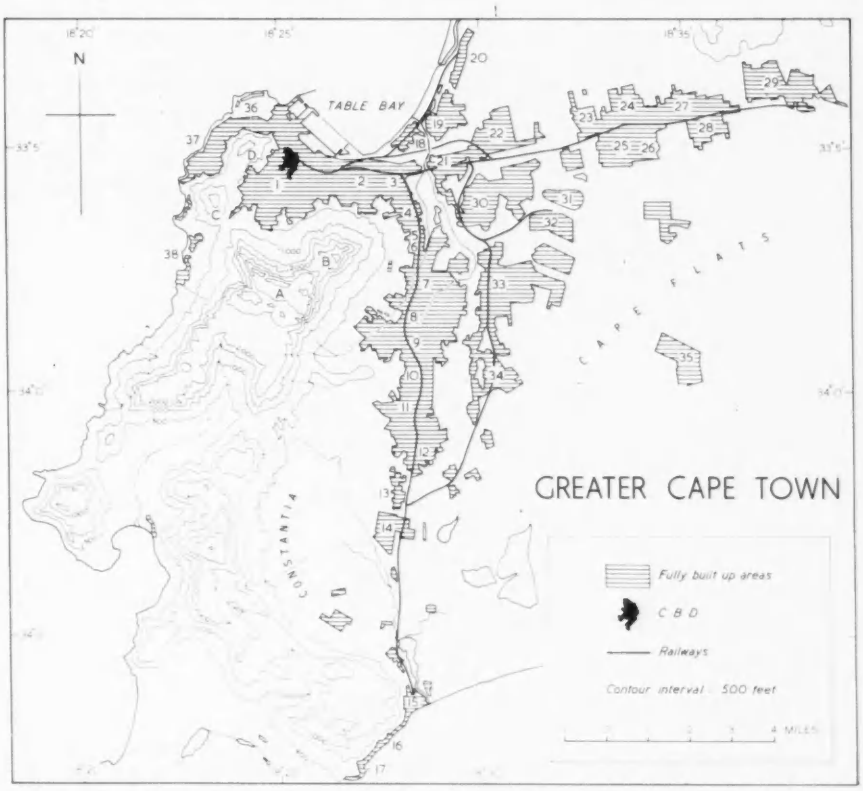

FIG. 1. Numbers refer to major districts in the built-up area as follows: 1. Central Cape Town, including CBD; 2. Woodstock; 3. Salt River; 4. Observatory; 5. Mowbray; 6. Rosebank; 7. Rondebosch; 8. Newlands; 9. Claremont; 10. Kenilworth; 11. Wynberg; 12. Plumstead; 13. Dieprivier; 14. Bergvliet and Heathfield; 15. Muizenberg; 16. St. James; 17. Kalkbaai; 18. Paarden Eiland (Industrial Area); 19. Brooklyn; 20. Milnerton; 21. Maitland; 22. Windermere; 23. Goodwood; 24. Vasco; 25. Epping; 26. Elsiesrivier; 27. Parow; 28. Tiervlei; 29. Bellville; 30. Pinelands; 31 Epping (Industrial Area); 32. Langa (Native Location); 33. Athlone and Crawford; 34. Lansdowne; 35. Nyanga (Native Location); 36. Green Point; 37. Sea Point; 38. Camps Bay and Bakoven. Letters refer as follows: A. Table Mountain (3566′ m.s.l.); B. Devils Peak (3284′ m.s.l.); C. Lions Head (2196′ m.s.l.); D. Lions Rump (part of Signal Hill 1153′ m.s.l.). The Fish Hoek and Simonstown municipalities, also tributary to Cape Town, lie just off the map to the south.

Based on the following Trigonometrical Survey 1:25,000 Sheets: 1. Cape Peninsula Sheet I (1958); 2. Cape Peninsula Sheet II (1957); 3. Sheet 3318DC Bellville (1941); 4. Sheet 3318DCD Bellville (1942). Information from Sheets 3 and 4 revised from 1:18,000 Cape Flats Regional Topographical Survey Sheets (1957–1958).

in the form of ribbon development of suburbs outwards from the City. Thus, while the physical limitations of its site tended to restrict the growth of Cape Town, to confine it within the Table Valley amphitheatre, narrow tongues of suburbs reached out between the mountains and the sea and then spread rapidly on the easier terrain beyond, swallowing up existing and separate villages in the process.[3] Through the "gate" between Devils Peak and the coast, suburbs pushed eastwards and then southwards between the slopes of

[3] For example, Mowbray, Rondebosch, and a number of other suburbs in Figure 1.

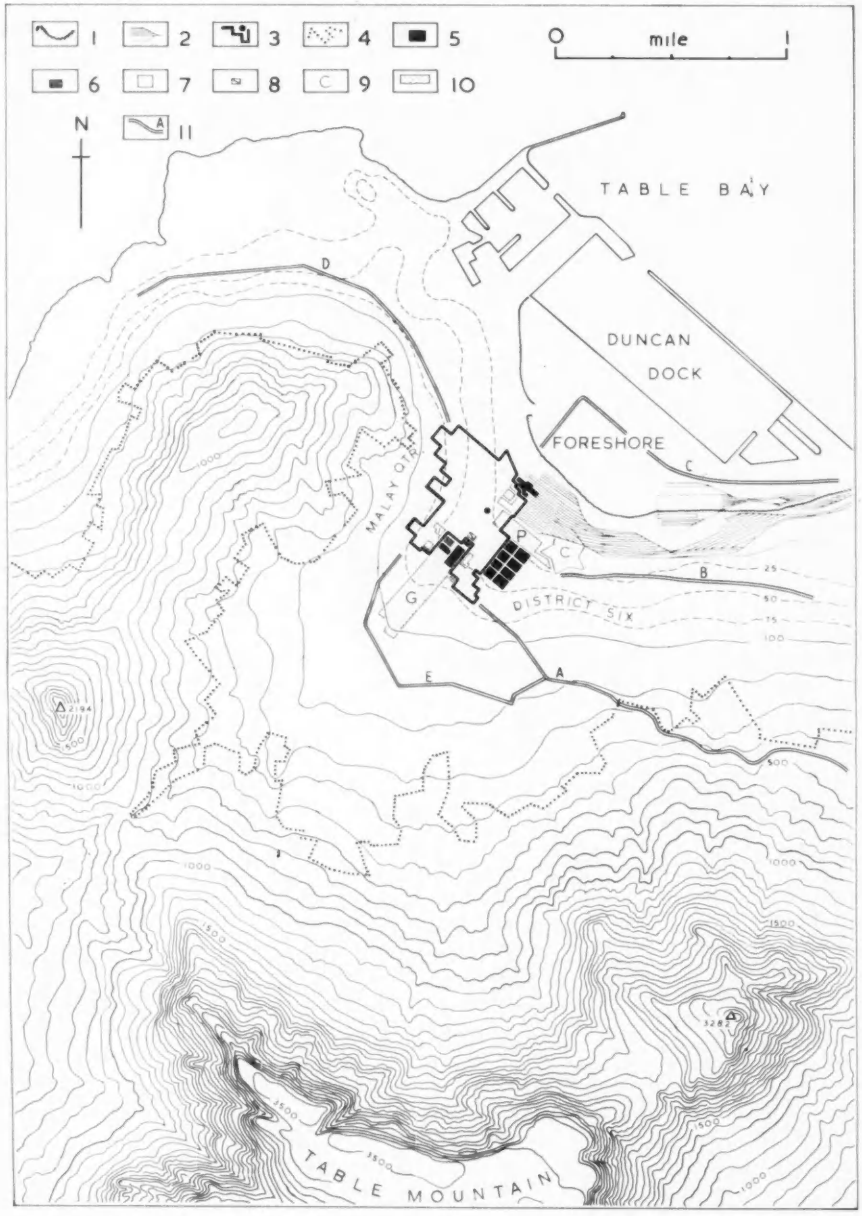

FIG. 2. The site of Cape Town's CBD. Numbers refer as follows: 1. The 1938 shoreline; 2. Railway yards; 3. CBD boundary; 4. Inner (mountain-slope) margins of built-up area; 5. Government and municipal blocks lying immediately beyond the CBD boundary; 6. St. George's Cathedral and School; 7. Government and municipal blocks within the CBD; 8. Groote Kerk; 9. Castle; 10. Public open spaces lying immediately beyond CBD boundary; 11. Major roads as follows:

A: Roeland St.–de Waal Drive; B: Darling St.–Sir Lowry Rd.; C: National Rd.; D: Somerset Rd.–Main Rd.; E: Long St.–Orange St. Contours are drawn at 100-foot intervals; in addition, the 25′, 50′ and 75′ contours are shown by means of broken lines. The passenger sections of the railway termini are shown within the CBD, other sections outside its boundary. The smaller Dock Area northwest of the Duncan Dock is the Victoria Basin.

Based mainly on the 1:25,000 Cape Peninsula Series of the Trigonometrical Survey Sheet 1, 1958.

the peninsular mountains and the sandy, initially repellant wastes of the Cape Flats, following the railway line to Muizenberg and Simonstown. More recently settlement has spread eastwards beyond the marshy land of the lower Liesbeck River and well into the Cape Flats along the line of a second suburban railway, while more expensive residences are now penetrating the old wine-farming lands of the Constantia embayment northwest of Muizenberg (Fig. 1).

From the Devils Peak gate similar, but more recent, development has also taken place along the main railway line and road which cut directly across the northern Cape Flats to the "mainland" and hinterland. Here a number of rapidly coalescing municipalities have

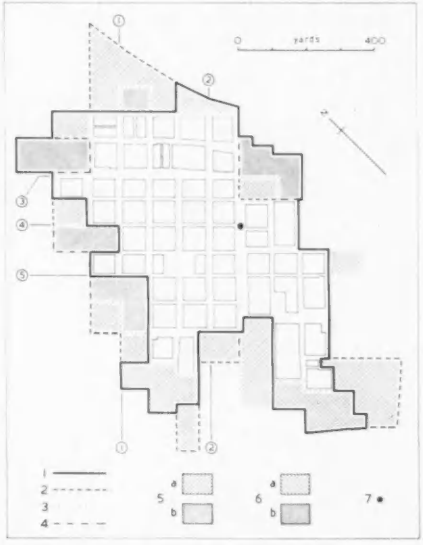

FIG. 3. The correspondence of three CBD boundaries. Numbers in key refer as follows: 1. Central Business Index (land use) boundary; 2. 5 per cent land valuation boundary, converted from a lot to a block basis (where not identical with "1"); 3. Composite traffic survey boundary (where not identical with "1"); 4. Joint 5 per cent land valuation and composite traffic survey boundaries (where not identical with "1"); 5. Areas outside Central Business Index boundary—(a) enclosed by only one other boundary, (b) enclosed by both other boundaries; 6. Areas inside Central Business Index boundary—(a) lying outside only one other boundary, (b) lying outside both other boundaries. Block outlines have been omitted in the shaded areas. See text for explanation of delimitation methods. Ringed numbers on map refer to particular streets as in Fig. 4. 7. Peak land value intersection.

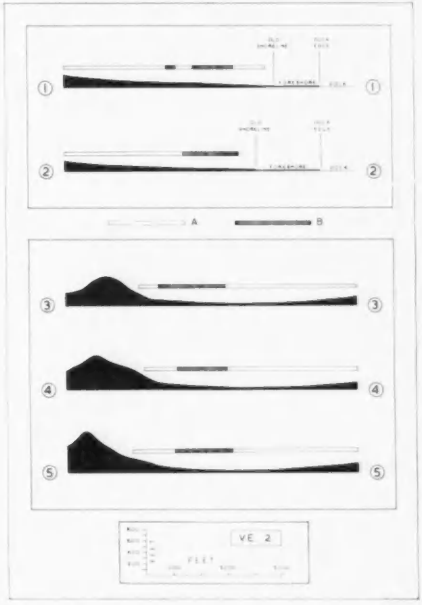

FIG. 4. Relief sections across Cape Town's CBD, approximately southwest to northeast (1 and 2) and northwest to southeast (3, 4, and 5). The sections are drawn down streets numbered as follows (the numbers corresponding with the ringed numbers of Figs. 3 and 5): 1. Loop Street; 2. St. Georges St.; 3. Strand St.; 4. Hout St.; 5. Longmarket St. Letters refer as follows: A. Fully-built-up section (see Figs. 1 and 2); B. CBD section. In both "A" and "B" where the CBD boundary runs *along* the section line the outer intersection of boundary and section line is indicated.

grown up, officially designated the "Northern Areas." On the Atlantic coast urban growth has extended northward to Milnerton and southward along the line of a coastal terrace[4] and the lower mountain slopes as far south as Bakoven, and plans are afoot to develop residential sites both further south and higher up the mountain slopes. Expanding rapidly, Cape Town has become an urban agglomeration with varied functions and a multi-racial population of 700,000.

Thus, where the terrain has permitted, suburbs have grown around mountain flanks and developed rapidly on easier ground beyond—particularly on the fringes of the Cape Flats. Due south, however, Table Mountain is an insuperable barrier, and the boundary of the built-up area is usually close to the 500 foot contour (Fig. 2). Generally speaking, Cape Town proper has filled the amphitheatre and can expand no farther; the more spectacular urban growth is now found in the outer suburbs.

Figure 1 shows that the CBD, as is typical in port cities, has now been left very much off-center by the growth of the total urban area and is, of course, within the oldest and most restricted part of it. Yet despite physical restrictions on the growth of Cape Town proper the CBD, set within it, must tend to expand with the growth of the *greater* Cape Town which it serves. There exists, therefore, a natural tendency for the CBD to exert some pressure outwards into the areas immediately surrounding it, replacing residences with commercial establishments. In the face of this pressure some inner residential districts have deteriorated into areas of overcrowded slums interspersed with the warehouses, wholesale establishments, and workshops characteristically peripheral to the CBD. This development of "urban blight" is well demonstrated in Cape Town in District Six (see Fig. 2), which lies southeast of the CBD, and its presence is an indication of CBD growth tendencies.

One of the most striking aspects of the urban structure of central Cape Town, however, is not so much this CBD growth as the presence of three barriers to it, each operating on a particular section of the boundary. The first of these is the physical barrier imposed progressively by relief as the mountain slopes are approached, for it is well-established that CBDs seek comparatively flat land wherever possible.[5] Figures 2 and 4 indicate that, since the CBD occupies a relatively small and central area of the wide amphitheatre, relief affects its growth only to the northwest, toward the lower slopes of Signal Hill. Elsewhere, there is ample near-flat land. The second barrier affects the northeast side of the CBD. Here growth was totally prevented until the last few years by the shoreline of Table Bay and by the railway line to the Docks which ran along it. The reclamation of the Foreshore between 1938 and 1945 has, however, provided another 160 acres for CBD development alone. The effects of these changes will be discussed later.[6]

[4] For more detail on the physical setting of Greater Cape Town see S. H. Haughton: *The Geology of Cape Town and Adjoining Country. An explanation of Sheet No. 247 (Cape Town)*, Pretoria, Government Printer, 1933, p. 49. Also see J. A. Mabbutt: "The Physical Landscape," in *The Cape Peninsula*, edited by J. A. Mabbutt. Cape Town, Maskew Miller, 1952, p. 21.

[5] See, for example, Raymond E. Murphy and J. E. Vance, Jr.: "A Comparative Study of Nine Central Business Districts," *Econ. Geog.*, Vol. 30, 1954, pp. 189–222, ref. p. 335.

[6] The Foreshore is the large area of land reclaimed from the seabed after 1938 between the new Duncan Dock and the old shoreline (see p. 34 and Figs. 2, 14, and 15). For the official account of the Foreshore plan, see Cape Town Foreshore Joint Technical Committee, *The Cape Town Foreshore Plan*. Pretoria, Gov-

(*Continued on next page*)

The third barrier is man-made and is present on the remaining southeast and southwest sides where there are no physical barriers. Owing to the continuously important administrative functions of Cape Town from its early days down to the present time, when it serves as the provincial as well as the national (legislative) capital, a comparatively large number of blocks of both government and municipal administrative buildings have grown up which fringe, and to some extent penetrate, the periphery of the CBD. Most of these were built after 1840 on the public open spaces which adjoined the CBD on these sides and which had restricted its growth in these directions since the earliest times. The barrier function of these particular areas thus remains unchanged.[7] While drawn to the center of the city by factors of centrality similar to those creating the CBD, these administrative blocks are essentially non-CBD in character: their business is not activated by the essential profit motive of the CBD, nor are they normally subject to public sale. Being essentially permanent in both site and function, they oppose the expansion of the CBD, which is unable to absorb them by the usual process of purchase and reconstruction. To these buildings must be added blocks which function in a similar manner; namely, the two public open spaces known as the Gardens and the Parade, the suburban and main line railway stations with their yards, and buildings such as the Groote Kerk (Dutch Reformed) and St. George's Cathedral and School (Anglican) (Fig. 2).

ernment Printer, 1948. Within the last two or three years the CBD has begun to spread onto the inner Foreshore. This has been ignored in CBD calculations as development there is too rapid to fix on a map, and the Foreshore is considered separately below.

[7] *Ibid.*, p. 7, and maps pp. 5 and 9.

Prior to the very recent reclamation of the Foreshore, therefore, the CBD was, with only minor exceptions which will be discussed below, restricted on all sides, thus increasing the tendency for upward growth. With this general picture of the CBD in mind, it is convenient at this point to consider its precise delimitation, so that the characteristics of its boundary may be considered in relation to the factors discussed above.

The Delimitation of the CBD

From the considerable literature of CBD delimitation a total of 16 possible methods were considered, from which seven were chosen for cartographic and field testing.[8] Finally, the Central Business Index (CBI) method developed by Murphy and Vance for American cities was adopted.[9] Based on land use, or the spatial distribution of urban functions, it appeared the most geographical as well as the most precise of the methods possible for Cape Town and enables a direct comparison to be made of Cape Town's CBD with those of nine American cities considered by Murphy and Vance. It should be noted, however, that Greater Cape

[8] The 16 methods were: (a) by the use of existing CBD boundaries—mostly official—none of which proved to be systematically derived; (b) the "template" method; (c) by the use of urban profiles; (d) the shop-rent index; (e) the trade-index; (f) by the use of block-frontage-volume of sales; (g) by population distribution; (h) by the distribution of dwelling units; (i) by patterns of employment; (j) pedestrian counts; (k) traffic flow study; (l) by delimitation based on the Cape Town Traffic Survey of 1957; (m) by land valuations; (n) the Central Business Index of land use; (o) by types of establishment at the CBD edge; and (p) by visual impression in the field. Of these methods, most—including all those not considered later in this article—are discussed in Raymond E. Murphy and J. E. Vance, Jr.: "Delimiting the CBD," *Econ. Geog.*, Vol. 30, 1954, p. 194 *et seq.*

The seven methods chosen from the above list for field and cartographic testing were c, h, l (two methods), m, n, and o. Visual impression in the field (p) was also used as a final check.

[9] Murphy and Vance, *op. cit.*, pp. 201–219.

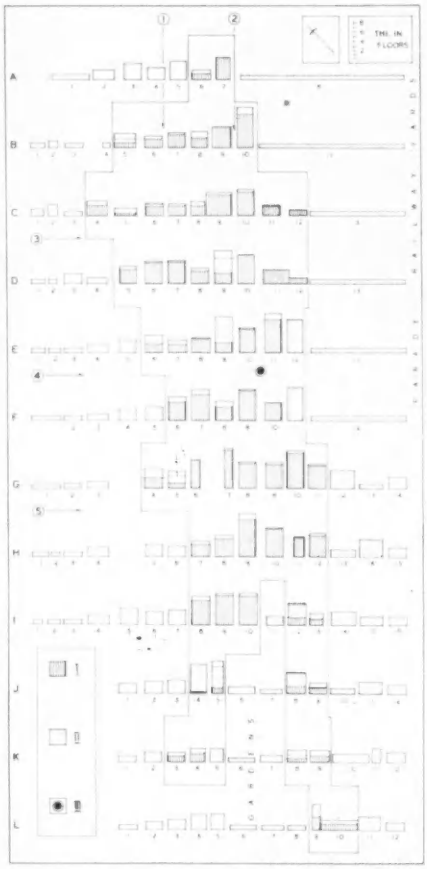

FIG. 5. Urban profiles across Cape Town's CBD. The profiles are drawn through blocks between northwest-southeast streets, the ringed numbers indicating particular streets as in Fig. 4. The height of each block represents the Total Height Index (THI), and the shaded sections (I on key) the Central Business Height Index (CBHI); the latter being shown only for blocks falling within the boundary of the CBD, as indicated by the continuous line enclosing the central blocks. The additional horizontal line which appears on some blocks between the CBHI and THI levels represents the corrected value for the CBHI after applying Murphy and Vance's Rules 3 and 4 (see page 330). The stippled blocks (II on key) are those considered to form a barrier to CBD expansion (see text). III on the key is the position of the Peak Land Value Intersection (PLVI) according to the 1945 Valuation. Note that all open spaces are drawn as one floor of land use.

Based entirely on field survey and office calculations; the latter being given in Table I.

Town with a population of 700,000, is considerably larger than any of the nine American cities covered by the American study. Nevertheless, this method proved very satisfactory in practice.

As this method has been fully described and discussed by its authors, only the briefest outline of it is necessary here. The land use on each floor of each lot in every city block which might conceivably fall within the CBD was recorded in the field and subsequently on maps. From this information three ratios were calculated for each block:

(a) The Total Height Index (THI), which is the total floor area of all lots in a block, divided by the total ground floor area of the block—i.e., the average height in floors of each block. This was used in the construction of the urban profiles in Figure 5 which are discussed below.

(b) The Central Business Height Index (CBHI), which is the total floor area of central business use[10] in a block divided by the ground floor area of the block (see Fig. 5).

(c) The Central Business Intensity Index (CBII), which is the proportion of all floor space in a block

[10] The major classification adopted for land use within the CBD was as follows: CA: Retail Business Uses: (a) Food, (b) Clothing, (c) Household, (d) Automobile, (e) Variety, (f) Amusement, (g) Miscellaneous; CB: Service, Financial and Office Use: (a) Financial, (b) Service Trades, (c) Headquarters Office, (d) General Office, (e) Transportation, (f) Transient Residences, (g) Parking. These two categories represent central business uses. Also plotted were, X: Non-Central Business Uses: (a) Residential, (b) Public and Government, (c) Organizational, (d) Industrial, (e) Wholesale, (f) Commercial Storage, (g) Vacancy. Each sub-group listed above was further subdivided to give a total of 64 land uses actually plotted. This detailed breakdown was required for aspects of the study not discussed in this paper. For delimitation purposes only the broad division into "C" (A and B) and "X" uses was required.

TABLE I

STATISTICS USED IN COMPILATION OF FIG. 5

Block	*THI*	*CBHI*	*Corr. CBHI*	*CBII (%)*	*Corr. CBII (%)*	*Block*	*THI*	*CBHI*	*Corr. CBHI*	*CBII (%)*	*Corr. CBII (%)*
A.1	1.12	....	.....	.....	.....	A.5	4.19	....	....	.....	.....
2	2.13	....	....	.....	.....	6	2.22	1.36	....	61.26	.....
3	3.57	....	....	.....	.....	7	5.00	5.00	....	100.00	.....
4	2.60	....	....	.....	.....	8	1.00	....	....	.....	.....
B.1	1.00	.....	.....	.....	.....	B.7	3.46	3.07	....	88.73	.....
2	1.50	.....	....	.....	.....	8	3.60	2.27	....	63.06	.....
3	1.00	.....	....	.....	.....	9	4.75	4.75	....	100.00	.....
4	1.12	.....	....	.....	.....	10	9.17	7.57	....	82.55	.....
5	3.06	1.10	2.01	35.95	65.69	11	1.00	....	....	.....	.....
6	2.62	2.06	....	78.63	.....	....	....	....	....	.....	.....
C.1	1.50	....	.....	.....	.....	C.8	3.15	2.29	....	72.70	.....
2	2.50	....	....	.....	.....	9	5.21	4.66	....	89.44	.....
3	1.00	....	....	.....	.....	10	5.87	5.41	....	92.16	.....
4	3.12	2.35	....	75.32	.....	11	2.43	2.21	....	90.95	.....
5	1.71	0.58	....	33.92	.....	12	1.33	1.33	....	100.00	.....
6	2.81	2.05	2.54	72.95	90.39	13	1.00	....	....	.....	.....
7	2.65	2.32	....	87.55	.....	....	....	....	....	.....	.....
D.1	1.00	....	....	.....	.....	D.8	3.42	2.81	....	82.16	.....
2	1.00	....	....	.....	.....	9	7.41	2.49	5.69	33.60	76.79
3	2.24	....	....	.....	.....	10	6.34	6.34	....	100.00	.....
4	1.38	....	....	.....	.....	11	3.05	3.05	....	100.00	.....
5	3.72	3.19	....	85.75	.....	12	1.33	1.33	....	100.00	.....
6	4.96	4.71	....	94.96	.....	13	1.00	....	....	.....	.....
7	5.09	4.85	....	95.28	.....	....	....	....	....	.....	.....
E.1	1.00	....	....	.....	.....	E.8	3.31	3.11	....	93.96	.....
2	1.00	....	....	.....	.....	9	7.89	2.30	....	29.15	.....
3	1.00	....	....	.....	.....	10	5.47	5.34	....	97.62	.....
4	2.00	....	....	.....	.....	11	8.73	7.34	....	84.08	.....
5	2.70	....	....	.....	.....	12	7.22	0.00	7.22	00.00	100.00
6	3.71	1.98	....	53.37	.....	13	1.00	....	....	.....	.....
7	2.67	1.89	....	70.79	.....	....	....	....	....	.....	.....
F.1	1.00	....	....	.....	.....	F.7	6.86	5.82	....	84.84	.....
2	1.00	....	....	.....	.....	8	4.28	3.03	....	70.79	.....
3	1.50	....	....	.....	.....	9	6.82	6.25	....	98.97	.....
4	2.47	....	....	.....	.....	10	4.00	4.00	....	100.00	.....
5	2.89	....	....	.....	.....	11	7.22	0.00	7.22	00.00	100.00
6	5.04	4.11	....	81.55	.....	12	1.00	....	....	.....	.....
G.1	1.00	....	....	.....	.....	G.8	5.83	5.57	....	95.54	.....
2	1.10	....	....	.....	.....	9	5.69	5.29	....	92.97	.....
3	1.60	....	....	.....	.....	10	8.26	7.82	....	94.67	.....
4	4.29	2.36	....	55.01	.....	11	5.36	5.09	....	94.96	.....
5	3.85	1.51	2.75	39.22	71.42	12	4.00	....	....	.....	.....
6	6.34	6.34	....	100.00	.....	13	1.00	....	....	.....	.....
7	8.81	8.43	....	95.69	.....	14	2.84	....	....	.....	.....
H.1	1.00	....	....	.....	.....	H.9	9.52	8.10	....	85.08	.....
2	1.00	....	....	.....	.....	10	6.34	6.03	....	95.11	.....
3	1.00	....	....	.....	.....	11	4.47	4.16	....	93.06	.....
4	2.00	....	....	.....	.....	12	5.22	4.63	....	88.70	.....
5	2.66	....	....	.....	.....	13	1.70	....	....	.....	.....
6	2.43	....	....	.....	.....	14	4.00	....	....	.....	.....
7	3.43	2.72	....	79.30	.....	15	2.38	....	....	.....	.....
8	4.73	3.90	....	82.45	.....	....	....	....	....	.....	.....
I.1	1.00	....	....	.....	.....	I.9	6.89	6.57	....	95.36	.....
2	1.00	....	....	.....	.....	10	6.88	6.44	....	93.60	.....
3	1.00	....	....	.....	.....	11	2.00	....	....	.....	.....
4	2.00	....	....	.....	.....	12	4.71	1.60	4.60	33.97	97.66
5	3.80	....	....	.....	.....	13	2.67	1.22	1.38	45.69	51.69
6	2.99	....	....	.....	.....	14	2.92	....	....	.....	.....
7	3.32	....	....	.....	.....	15	2.00	....	....	.....	.....
8	6.47	5.36	....	82.84	.....	16	2.00	....	....	.....	.....
J.1	2.30	....	....	.....	.....	J.7	1.00	....	....	.....	.....
2	2.74	....	....	.....	.....	8	4.71	1.60	4.60	33.97	97.66
3	3.07	....	....	.....	.....	9	2.67	1.22	1.38	45.69	51.69
4	6.53	0.31	6.53	4.75	100.00	10	1.38	....	....	.....	.....
5	7.48	1.16	6.00	15.51	80.21	11	2.83	....	....	.....	.....
6	1.51	....	....	.....	.....	12	1.75	....	....	.....	.....
K.1	1.31	....	....	.....	.....	K.7	1.52	....	....	.....	.....
2	2.31	....	....	.....	.....	8	2.78	0.84	1.57	30.22	56.47
3	2.26	1.31	....	57.96	.....	9	2.67	1.22	1.38	45.69	51.69
4	3.07	1.87	....	60.91	.....	10	1.88	....	....	.....	.....
5	3.00	0.00	3.00	00.00	100.00	11	3.10	....	....	.....	.....
6	1.00	....	....	.....	.....	12	2.30	....	....	.....	.....
L.1	1.00	....	....	.....	.....	L.7	1.00	....	....	.....	.....
2	1.74	....	....	.....	.....	8	1.00	....	....	.....	.....
3	2.33	....	....	.....	.....	9	5.77	2.97	....	51.47	.....
4	3.39	....	....	.....	.....	10	2.24	1.45	....	64.73	.....
5	3.51	....	....	.....	.....	11	2.93	....	....	.....	.....
6	1.00	....	....	.....	.....	12	1.80	....	....	.....	.....

Blocks are numbered as in Figure 5, which should be studied in conjunction with this table. As in Figure 5, the THI is given for all blocks, but the CBHI and CBII only for those blocks within the CBD boundary. Where blocks with a CBHI of less than 1.00 and a CBII of less than 50 per cent are included within the CBD by virtue of Murphy and Vance's Rules 3 and 4 (see p. 330), the corrected CBHI and CBII values are given. The columns with these values are headed "Corr. CBHI" and "Corr. CBII."

in central business use, expressed as a percentage.

All three ratios are listed in Table I for each block finally included in the CBD.

The extent to which the land use within a block may be considered to be of a central business character is expressed by (b) and (c). On this basis a block was considered to fall within the CBD if its CBHI was one or more *and* its CBII 50 per cent or more, the combination of the CBHI and the CBII being termed the Central Business Index, or CBI. Additional rules of delimitation to deal with special problems, also put forward by Murphy and Vance, were adopted in their entirety in the Cape Town delimitation.[11]

In addition, two minor modifications were considered necessary in this case.[12] The first derives from the fact that central Cape Town includes three or four very long blocks which tend to intersect the CBD boundary at right angles. These have a markedly decreasing central business character away from their inner, or CBD ends. As the rules stand, they would have to be calculated as single blocks, despite the fact that they are several times greater in area than the average, roughly square city block. The CBI for each of these blocks represents at best only average conditions which in actual fact are found only in the central portions. For example one such block, calculated originally to fall just within the CBD, included large warehouses at the outer end but had sizable retail stores at its inner end. It was felt justified to split such blocks into sections comparable in area with the average city block and to make separate calculations for each section. It was found that the municipal authorities had base maps with such subdivisions of long blocks; as these appeared entirely logical, they were adopted in this delimitation.[13] For this reason the CBI boundary in one or two places runs *across* a long block (Fig. 3). Modified in this way, the CBI boundary was found to accord better with those boundaries established by the use of other criteria (and which were drawn as an independent check) as well as with the visual impression gained in the field.

The second modification was necessitated by the very large amount of

[11] The rules, quoted in their entirety from Murphy and Vance, *op. cit.*, p. 219, are as follows: (1) To be considered part of the CBD a block must be part of a contiguous group surrounding the peak value intersection. Even though a block touches the others only at one corner it is considered contiguous; (2) A block that does not reach the required index values but is surrounded by blocks that do is considered part of the CBD; (3) A block completely occupied by the buildings and grounds of a city hall or other municipal office building, a municipal auditorium, city police or fire department headquarters, or a central post office is included within the CBD if it is adjacent to blocks meeting the standard requirements. In some cities it will be necessary to add to this list the buildings and grounds of certain other government buildings: the courthouse in a county seat; the state capitol building of a state capital; and occasionally certain federal buildings in addition to the post office, e.g., a federal court building or other federal office building the activities of which are closely integrated with those of the city and the region. In no instance should such government buildings as those described in this paragraph result in the extension of the CBD for more than one block beyond normal CBD blocks. Thus where there is a group of state buildings occupying several blocks that border the CBD, as in some state capitals, the whole group is considered non-CBD; (4) If the structures mentioned in Rule 3 occupy only part of a block which is contiguous to other CBD blocks and if the inclusion of these establishments as central business would bring the two indexes of the block to the required totals then the block is considered part of the CBD.

[12] A further modification adopted here was to construct land use maps for the ground, second, third, and composite upper floors—a total of four maps, as opposed to three (ground, second and composite upper) in Murphy and Vance. This, however, does not directly affect the method of delimitation.

[13] Maps accompanying S. S. Morris: "Parking in the Central Business District of Cape Town," Cape Town, City Engineer's Department, Municipality of Cape Town, 1957 (unpublished).

rebuilding in central Cape Town. Wherever reconstruction was in progress at the time of the field survey,[14] it was not possible to determine the future land use as the majority of such shops and offices had not then been let. So many lots were affected that some rule to deal with them was required. It was decided to omit them entirely from the calculations already described including, of course, those of the ground floor areas of blocks. In this way discrepancies between blocks were minimized as far as possible and calculations were based only on known facts. Nevertheless, as the information mapped applies only to the time of the field work the rapid construction of new blocks, mostly quite tall, will possibly require slight shifts in the CBD boundary in subsequent land use maps drawn on the same basis. With the development of the Foreshore and the likelihood of a shift of the peak land value intersection towards it some change of the CBD boundary is, in any case, almost inevitable.

Although the CBI method, in the very slightly modified form outlined above, was used in the actual delimitation of the CBD boundary as shown in the Figures, boundaries based on two of the remaining six methods tested in the field were also drawn in their entirety as an independent check.[15] These were:

(a) The 5 per cent land valuation line, based on the 1945 valuation, the latest available.[16] This boundary was drawn enclosing blocks with a valuation of 5 per cent or more of that of the peak block.[17]

(b) A boundary based on a consideration of traffic within the CBD, as determined by a recent municipal survey.[18] In the first place maps based on statistics indicating the principal block visited by each car driver on the day of the survey were studied as a sample of the total of daily visits. A boundary was then drawn enclosing blocks where visits totalled 20 per cent or more of those to the peak block. Secondly, the excess of drivers wishing to park around each block over the number of spaces legally available, which was recorded on another map, was studied; and a second boundary drawn enclosing blocks where the excess during the peak hour was at least 100 per cent. These two boundaries, each expressing slightly different aspects of the pull of the CBD in terms of traffic, were then combined to form one composite traffic boundary: where the two diverged, the outer was taken as the boundary. It was felt desirable to check one against the other in this way as the field surveys on which they were based were not carried out concurrently.[19]

The land valuation and composite traffic boundaries are shown on Figure 3. Both are based on data which express important characteristics of the CBD, as does the land-use data on

[14] July, August 1957.

[15] In addition, the distributions of certain establishments—warehouses, wholesale establishments, furniture stores and automobile establishments—said to characterize the CBD fringe—were plotted without any positive contribution to delimitation problems resulting.

[16] For description of this method see Murphy and Vance, *op. cit.*, p. 198.

[17] The Cape Town valuations are expressed as *lot* land values; these were converted to average values per *block* before calculating each block as a percentage of the peak value block.

[18] This information is recorded in Morris, *op. cit.*, particularly in accompanying maps TS2 and TS3. The author, however, is entirely responsible for the boundary derived from it.

[19] The first boundary was based on data collected by a card survey on Thursday, May 24, 1956; the second was based on data collected by a curb survey mainly carried out from the 10th to the 16th of June, 1956.

which the actual CBD boundary was based. Once again, the boundaries are expressed as percentages of a peak, so that comparisons with other cities can be drawn.

AN INTERPRETATION OF CERTAIN ASPECTS OF THE CBD BOUNDARY

Certain aspects of the CBD boundary may now be examined.

Correlation of the Three Boundaries

The land valuation and composite traffic boundaries were calculated and drawn in with the CBI (land use) boundary on Figure 3 both as a check on the validity of the latter and in the hope that the nature of any disparity between them—which was naturally expected—would in itself throw some light on the character of the CBD boundary as a whole. They were intended, in other words, as a tool for an analysis of the boundary.

Figure 3 reveals, on the whole, a most satisfactory correlation between the three boundaries, which are rarely more than a block apart. Since, as has been pointed out, they are based on entirely different criteria, it is felt that the validity of the actual boundary—the CBI boundary—is generally confirmed by this figure.

The existence of certain areas of disparity between the three boundaries is, however, of equal significance and greater interest. These are shown on Figure 3 by various types of shading. It will be noted that in certain sectors the three boundaries coalesce to form a single *line*; and here the CBD boundary is fully acceptable. More commonly, however, the boundary is in actual fact a *zone*, indicated by the shading, which lies between the divergent sections of the boundary lines. There is, therefore, a *varying quality* to the CBD boundary—a feature which must surely be present in most cities. Presumably the zonal sections rather than the linear sections of the boundary represent the "normal" state of affairs, and the former would, of course, tend to be proportionately increased by the plotting of additional boundaries based on differing criteria.

It is suggested that a contribution might be made to the analysis of many CBDs by plotting a number of differing boundaries in this way and locating and examining what might be termed the "blurred" and "sharp" sections of the CBD periphery. In this instance it is hoped to demonstrate that this varying quality is the result of the barriers to outward growth which have already been described.

An examination of Figure 3 reveals that although the zonal sections are distributed all around and also penetrating the CBI boundary, it is possible to discern some pattern in their distribution. Most important is the linear section on the southeast side of the CBD, which is the only one extending for more than a block in length. Indeed, if the railway passenger station buildings—now partly within and partly outside the CBD—are entirely excluded, as they would be if the entire station area were considered as one block, this linear section would extend almost the entire length of the southeast side. By contrast, the other three sides are essentially zonal in character. This contrast may be interpreted in the light of restrictions to outward growth already described.

Figures 2 and 3 show the southeast side flanked by the major concentrations of government and municipal blocks in Cape Town, and by others which have a similar effect. Starting from its northern edge, this boundary is flanked in turn by the railway stations

FIG. 6 (upper left). The critical southeast edge of the CBD looking west from the Parade. This is the hard core area, with the buildings in the center and to the right—both part of the main post office—standing on the area of public ground yielded to CBD expansion during the nineteenth century (block E12 and F11 calculated as one block, Fig. 5). The office building on the left is claimed to be the tallest completed building in South Africa. The Parade is the only large car park close to the hard core.

FIG. 7 (upper right). A view of the Parade, looking southeast from the roof of the main post office (Fig. 6) at the CBD edge. The Darling Street artery is on the right and Cape Town Castle, the oldest existing building in the Union, in the left background. The Parade is filled with parked cars soon after 9 a.m. each working day.

FIG. 8 (lower left). Another view from the Post Office roof looking east. The platforms of the passenger stations in the left foreground lie across the extension to Strand Street (Fig. 3) and occupy the space between the Parade (right foreground) and the 1938 shoreline. The new goods station on the Foreshore is in the left background. In the right center the railway tracks have truncated a corner of the Castle as they pass between it and the 1938 shoreline.

FIG. 9 (lower right). Dock Road, Cape Town looking southeast from a point near the CBD northeast boundary. The older buildings on the right are part of the CBD (Blocks A6 and A7, Fig. 5), while the new block on the left is part of the very recent Foreshore development. The CBD boundary runs along Dock Road at this point and the 1938 shoreline parallel to it and close to the block on the left. Note Devils Peak in the background, and the limit of settlement on the lower slopes.

and yards, the Parade (Figs. 6 and 7)—a public open space used as a car park—and by a set of eight public administrative and associated blocks.[20] Around the southwest side of the CBD these are continued by the Gardens—a large public park and formerly part of the gardens of the original victualing station, more official buildings,[21] and also blocks such as the Groote Kerk, St. George's Cathedral and School, and the Public Library. It is these blocks which cannot be absorbed into the CBD, and which check its outward growth.

To some extent Figure 3 reflects cartographically this restriction. Under what might loosely be termed "nor-

[20] Including the City Hall, municipal offices, a central police station, the Magistrate's Court, the Department of Inland Revenue, and the Cape Technical College. This is the major concentration of public administrative blocks in Cape Town.

[21] Including the Supreme Court building, and the Provincial Administration building.

mal"[22] circumstances there are relatively few artificial barriers to outward growth, and the CBD tends to merge gradually into a surrounding zone of urban blight. In such circumstances certain urban functions of the CBD—i.e., spatial distributions within it—tend to expand more extensively in space and rapidly in time than others. There results a natural positional disparity between boundaries based on different criteria, which may amount to several city blocks in width. On the other hand, if severe checks on the outward growth are imposed fairly near to the CBD center, as is the case on this southeast side (note the position of the peak land value intersection in Figure 3), then these different boundaries, which are dynamic rather than static and may be thought of as spreading slowly outwards in response to "pressure" being built up within the CBD like the ripples when a stone is flung into a pond, fetch up abruptly against this man-made barrier, short of their "natural" limits. In this way, they "overtake" one another and coalesce into a single-line boundary. Although clearly defined, such a boundary may well be a cartographic demonstration of artificial CBD constriction.

But it is also noticeable that the southwest side, almost as rigidly restricted by these artificial barriers, retains a zonal boundary, as does the northeast side, which was until very recently restricted by the old shoreline. If the barriers on these sides are little, if any, less rigid, why have linear boundaries not evolved here as well? The reason is surely that both barriers *and* a marked outwards pressure are necessary for turning a zonal into a linear boundary. While the barriers are, or have been, present on these two sides the pressure exerted by the CBD has been inadequate for the purpose. It is generally recognized that such pressure is principally communicated along major arteries from the CBD[23]—for CBDs grow outwards along such arteries with development in the interstices lagging behind—and, in marked contrast to the southeast side, these two sides have lacked arteries of the first rank. Since the 1938 shoreline prevented expansion across the northeast boundary until recently the railway to the docks (i.e., the docks northwest of the Duncan Dock, which was not then constructed) used to follow it across the foot of Adderley Street. Only with the reclamation of the Foreshore has the Adderley Street extension to the National Road been constructed across this boundary, and within the last three or four years new CBD buildings have begun to spring up along it (Figs. 2, 9, and 10). The construction of the Duncan Dock has at the same time shifted the center of port activities further southeast and more in line with this new artery, further strengthening the tendency for CBD expansion across its old boundary. Such development is, however, only just beginning.

To the southwest there are no railway lines and only one road artery of moderate importance, namely Long Street–Orange Street (Fig. 2). This latter, leading to de Waal Drive, serves in this way as an additional outlet to the southeast, but is too circuitous to take as much traffic as the direct outlets of Roeland Street and Darling Street on the southeast side; consequently little pressure has developed on this side of the boundary. The essential point is

[22] It may well be that the presence, rather than the absence, of barriers is the "normal" state of affairs in the western-type CBD. Comparative studies do not appear to have been carried far enough to decide this point, which appears important.

[23] See George W. Hartman: "The Central Business District—A Study in Urban Geography," *Econ. Geog.*, Vol. 26, 1950, pp. 239 *et seq.*

FIG. 10. New shops and offices on the Foreshore, completed 1957–1958. The photograph shows the rear of the blocks with their parking area, their fronts facing onto the Adderley Street extension, beyond the picture to the right. Building heights and styles are controlled on most of the Foreshore.

that to the southwest lie only inner residential suburbs, and the only heavy traffic is that passing through via Orange Street to the southeast. This is sufficient, however, to result in a small tongue of the CBD pushing outwards along the northwest side of the Gardens, centered on Long Street.

The northwest side suffers least from restrictions to growth, being affected only by the increasing slope of the ground towards Signal Hill; and thus displays best of all the "normal" characteristics of CBD growth, with a zonal boundary. As will be shown below, the CBD grew steadily northwestwards towards this boundary through the progressive purchase of residential establishments, street by street, and their conversion to retail and business premises. Beyond the zonal CBD boundary lies the zone of urban blight known as the Malay Quarter (see Fig. 2). It is likely that the natural limit of CBD expansion had been reached here even before the release of pressure through the Foreshore developments, owing to the increasing slope and the lack of through communications. The influence of slope is well shown on Figure 2, for the CBI boundary—allowing for the rectilinear shape resulting from its block basis—runs parallel with the contours and not along one of the northeast-southwest streets.

The Shape of the CBI Boundary

The varying quality of the CBD boundary is thus a result of the existence of barriers to outward growth. The actual shape of the boundary is a further result and a further step may be taken by examining more closely the outline of the CBI boundary. It is not proposed in this context to attempt to find any geometric patterns along the lines developed by Hartman[24]—physical con-

[24] *Ibid.*, pp. 238–239.

trols being strong enough here to result in an essentially irregular CBD shape—but rather to examine the nature of irregularities. In passing, however, it might be noted that the rectilinear outline of the CBI boundary, while in detail the result of the block basis of calculation, owes a good deal to the characteristic grid pattern of the original Dutch settlement, with its broad southwest-northeast roads from the Gardens to the shore linked by less important lanes running at right angles; for the present street plan is still based on this grid.

It should also be noted that the land valuation and composite traffic boundaries have served their purpose, the CBD boundary considered from now on being the actual CBI or land use boundary chosen. Examining this CBI boundary on Figures 2 and 3, it will be seen that it tends to squeeze out, between the various barriers, both in the south and north corners.[25] The south corner is the important road exit to the southern suburbs via Roeland Street and de Waal Drive, and is the best example on these figures of the tendency for spread along major arteries. In the sense that it lies between the restricted southeast and southwest sides, this south corner is a "gate" from the CBD leading to the Devils Peak gate from Cape Town to its main outer suburbs. De Waal Drive, however, is designed principally for fast private car traffic bringing commuters to and from the southern suburbs and bypasses the centers of those suburbs. Heavy commercial traffic thus largely avoids this route. As this exit also lacks a railway, it is not the major exit to either the southern suburbs or the eastern hinterland but is essentially supplementary to the main route which runs through the center of the southern suburbs (Fig. 1). This leaves the CBD via Darling Street, along the southwest side of the Parade, and carries most of the heavy commercial traffic and much of the lighter traffic moving southwards (Fig. 2). Heavy traffic for the Northern Areas and the hinterland also leaves by Darling Street, forking left for the Voortrekker Road to the interior across the northern Cape Flats just beyond the margins of Figure 2. From the opposite side of the Parade, the railways also serve the same areas. These routes flanking the Parade are, therefore, Cape Town's main link with its outer suburbs and hinterland, and the pressure of CBD growth is at a maximum at these points on the boundary. The fact that this is not reflected in a bulge in the boundary is an indication of the effect of the barrier blocks, which completely seal off this side and separate the CBD from the factories and slums of Woodstock and District Six. It should be noted, however, that there was an outward movement of the boundary in the nineteenth century, when buildings were constructed on the northwest part of the Parade, which originally ran through to Adderley Street. These buildings are now represented by blocks E11, F10, and E12 and F11 (same block on Fig. 3) on Figure 5. Resistance to expansion along this side was thus effective only after a slight initial yielding to pressure at a time when Cape Town began to grow rapidly.

Work has now commenced on the new mainline and suburban passenger stations on the Foreshore, which will entirely replace the existing stations. This will leave space which could be used for CBD expansion near the east corner. The move, however, will bring the railway termini near to the new National Road to the hinterland, which, although

[25] This tendency becomes even more marked if the long city blocks are not split up for purposes of CBI calculations.

only recently completed, is already drawing long distance traffic away from the Voortrekker Road to bypass the Northern Areas to their north. This road enters the CBD from the northeast or Foreshore side: together with the northward movement of the railway termini, the effect is to draw the main traffic exit away from the southeast side (although road exits around the Parade will remain important) and onto the Foreshore side. This was, in fact, intended, in so far that a large boulevard was proposed to collect traffic at present entering the CBD from the east and south—other than that entering via the National Road—and lead it onto the Foreshore.[26] Such a movement should decrease the tendency of the CBD for expansion along part of its southeast side at the same time that two barriers to that expansion—the railway termini—are removed. Instead, the CBD should begin to move across its former northeast boundary, towards the new main exits for railway and roads. Indeed, this movement has already been taking place over the last three or four years.

As regards the present boundary, however, the contrast between the east and south corners indicates that the CBD has tended to squeeze out *where it can*—i.e., along Roeland Street—but that the greatest pressure of all has been entirely withstood along the southeast side.

On the northwest side the boundary runs more or less along the 75-foot contour but there is, perhaps, a slight indication of a bulge developing at its northern end—the north corner. This is the main outlet to the Atlantic suburbs via Somerset and Main Roads (together with Dock Road to the northwestern Dock Area), and is in marked contrast to the roads which run outwards across the remainder of this side and which come to a dead end on the steepening slopes of Signal Hill (Figs. 2 and 4). This outlet, together with Roeland Street at the opposite corner, is noteworthy for its number of automobile establishments, which are said to characterize the CBD fringe.[27] The depth to which these establishments penetrate the CBD along these roads[28] may suggest rapid growth at these corners, and certainly reflects the high proportion of private vehicles using these routes. The Atlantic suburbs are essentially residential, and beyond them the route down the west coast of the Peninsula is used by comparatively little traffic other than summer tourist traffic. Being essentially for commuters, this northwest outlet is not as important as those leading eastwards and southwards from the CBD, although some heavy traffic for the northwestern dock area still uses Dock Road.

Thus certain irregularities in the outline of the CBD result from the same barriers to outward growth which created zonal and linear sections along the boundary. A further step may be taken by considering the three-dimensional aspect of the CBD boundary—the skyward boundary.

The Vertical Boundary: The Asymmetrical Pattern of Block Heights

It is generally recognized that, irrespective of site factors, the buildings in a typical western-type CBD tend to grow upward in response to the desire

[26] By September, 1958, there appeared to be disagreement as to whether to proceed with this scheme between the City Council (which had rejected it in August, 1958) and the Provincial Administration (*Cape Times*, August 29, 1958; *Cape Argus*, September 17, 1958). It was later confirmed that the boulevard should be built.

[27] Murphy and Vance: "Delimiting the CBD," *op. cit.*, p. 200.

[28] Automobile establishments are thus strung along roads roughly at right angles to the CBD boundary. In no sense can they be said to characterize the CBD edge in Cape Town.

FIG. 11 (left). Shortmarket Street, Cape Town, approximately between blocks F6 and G5 (Fig. 5) looking southeast. A good example of the southeast-northwest cross streets which carry traffic across the CBD. Note that this is a one-way street; also the congestion caused by commercial loading operations. The photograph was taken at a relatively slack period in the early afternoon.

FIG. 12 (right). The PLVI on Adderley Street, Cape Town, looking northeast towards the Foreshore. The large block on the right comprises a department store and offices (Block E11, Fig. 5), beyond which is the suburban railway terminus (Block D11, Fig. 5).

for centrality, the high cost of land, and the known attraction of tall, modern office buildings with their superior amenities. Where there is a marked restriction to normal horizontal development, as has been the case in Cape Town, such a tendency is increased, and Cape Town has a considerable number of tall buildings in relation to the overall size of its CBD. In these circumstances the vertical or skyward boundary of the CBD should also be examined. While the presence of tall buildings would in itself signify little, any marked *variation* in average block heights—i.e., in the Total Height Index—could be revealing. In particular, since the restriction on horizontal growth is unevenly applied around the periphery, some asymmetry in the vertical plane would appear a likely result. It would be reasonable to expect to find the highest blocks not in the geographic center of the CBD, but near to the southeast boundary where restriction is greatest and the build-up of "pressure" is at a maximum.

A complete series of urban profiles was, therefore, drawn across the CBD from northwest to southeast, each profile being drawn along the center of a line of city blocks (Fig. 5). The height of each block is expressed in floors and in terms of the Total Height Index as described earlier (page 328). Examining, for the moment, only the *total* height

of each block, it will be observed that the THIs increase gradually southeastward from the Signal Hill slopes, with some tendency for a sharper increase at the CBD boundary and another further into the CBD, where there is clearly a hard core (see profiles D and E, Fig. 5).[29] Proceeding southeastwards from the CBD center, however, the profiles do not all decrease as gradually in height. Some tend to flatten out, or even go on rising, towards the southeast boundary, where they fall abruptly to the open spaces of the railway yards and the Parade (Fig. 6). This is noticeable in profiles A, B, E, and F; if the railway termini buildings are accepted as being atypical—and they are excluded from the CBD according to the other boundaries drawn in Figure 3—the same tendency is evident in profiles C and D. Thus the constriction on the southeast side is demonstrated by asymmetry in the vertical plane. On the other hand, where the Roeland Street artery leaves the southern corner, the local release of pressure is expressed by the increasing symmetry of the profiles—particularly profiles H, I and J.

It is possible to draw only rather general and limited conclusions along these lines, since new city blocks are artificially controlled in height by planning regulations. These, however, are themselves influenced by varying needs in different parts of the CBD, while most blocks whose profiles are drawn in Figure 6 are made up mainly of buildings of either pre-war or early post-war date, which were not so restricted. These limited conclusions would thus appear valid. It may be noted that the oldest part of the city has today, with the exception of the very recently developed area on the Foreshore, the highest and many of the newest buildings.

The Central Business Height Index—or amount of floor space devoted to CBD uses—was also drawn in on Figure 5 for each block within the CBD (CBI) boundary. While an examination of these CBHI levels does not throw very much light on the subject it does, on the whole, and making allowance for the effect of certain essentially non-CBD blocks now engulfed in the CBD,[30] tend to confirm the asymmetrical pattern of the THIs.

As far as Cape Town is concerned, the idealized shape of the CBD seems best to conform to a modified pyramid,[31] but, in response to the restrictions, it is most definitely an asymmetrical pyramid.

The CBD Boundary in Time: The Asymmetrical Pattern of Historical Growth[32]

It is frequently and rightly stressed that the CBD must be considered as a three-dimensional figure. In this context, at least, the fourth dimension of time is also relevant, and an examination of the geographical pattern of the historical growth of the CBD is a further step in boundary analysis. Unfortunately, it is difficult to deduce from historical records the various positions of the CBD boundary in the past, for old maps do not sufficiently distinguish between the functions of buildings for this purpose, while written records tend

[29] It is hoped to delimit this hard core in a later study.

[30] Notably block E9, which is dominated by a large wholesale establishment.

[31] See Hartman, *op. cit.*, and Murphy and Vance: "A Comparative Study of Nine Central Business Districts," *op. cit.*, pp. 328–330.

[32] Some of the information in this section is derived from M. Marshall: "The Growth and Development of Cape Town," unpublished M.A. thesis, Geography Department, University of Cape Town, 1944. For a concise account of the historical geography of Cape Town and the Cape Peninsula, also see W. J. Talbot: "Town and Country: Past and Present" in *The Cape Peninsula*, *op. cit.*, Chap. 7, pp. 144–176.

to refer only to particular points in time and space. It is possible, however, to plot from old maps the growth of the total built-up area of Cape Town in a series of historical stages, and this has been done in Figure 13 up to 1810, by which time the area of the present CBD was entirely built up.[33] It will be noted that the oldest part of the city is not geographically central to the present CBD, but well to the east with its axis along the Heerengracht—the present Adderley Street.[34] From this axis the steady growth of the built-up area towards Signal Hill is evident, and historical records give some indication of the similar growth of the CBD within this total growth, although it is not possible to draw a precise boundary. Shops began to appear among the residences of Adderley Street around 1822, while those streets parallel with Adderley Street on its northwest side changed gradually from residential to CBD functions throughout the nineteenth century.[35] Thus, while there is a marked time-lag between the growth of the built-up area as shown in Figure 13 and the growth of the CBD, the latter has also been steady and logical.

On the southeast side, by contrast, Figure 13 suggests far less extensive and steady development of the built-up area and, by inference, of the CBD. Building during period 3 is entirely absent from the map on this side, with the still-open spaces of the Parade and the present railway yards alongside the oldest built-up section of the city, while period 5 is represented only by a small enclave. On theoretical grounds one might well suppose that the main growth (once growth took place with the ending of the early period as a victualing station divorced from the hinterland) would be eastward towards the hinterland on which the growth of Cape Town came increasingly to depend. In actual fact the CBD growth towards the dead end of Signal Hill has been far greater in terms of distance than that towards the east where the boundary lies very close to the original Adderley Street axis. This asymmetry in the historical growth of the CBD is a further expression of the artificial restriction caused by the administrative blocks to the southeast.

It may be objected that this conclusion is unsound, since most of the public administrative blocks concerned were constructed after the advent of municipal government in 1840—too late to prevent any outward growth of the CBD in this direction. It might, in fact, be supposed that the existence of open ground on this side as late as the nineteenth century shows that there was little natural tendency for growth in this direction. The answer to this objection is that, prior to the construction of these blocks—as has been pointed out—there existed a large area of publically-owned open space all along this side, of which the Parade is only a remnant. This ground was not generally available for CBD expansion but was made available for the construction of these administrative blocks in the nineteenth century. In other words, the restrictive character of the ground on this side has been present from the beginning, the present buildings being only the post-1840 expression of it. CBD growth has thus always been effectively barred to the southeast, at

[33] The present CBD area was essentially built up by 1767. See P. W. Laidler: *A Tavern of the Ocean*, Cape Town, Maskew Miller, 1926, p. 184.

[34] See G. M. Theal: *A History of South Africa, 1486–1691*, London, Swan, Sonnenschein, Lowry and Company, 1888, p. 362.

[35] See W. W. Bird: *The State of the Cape of Good Hope in 1822*, London, John Murray, 1823, p. 149; C. J. Martin: *The Cape Directory for 1865*, Cape Town, 1865; British Association Reception Committee: *Handbook of Cape Town and Suburbs, 1905*, Cape Town, 1905, p. 215.

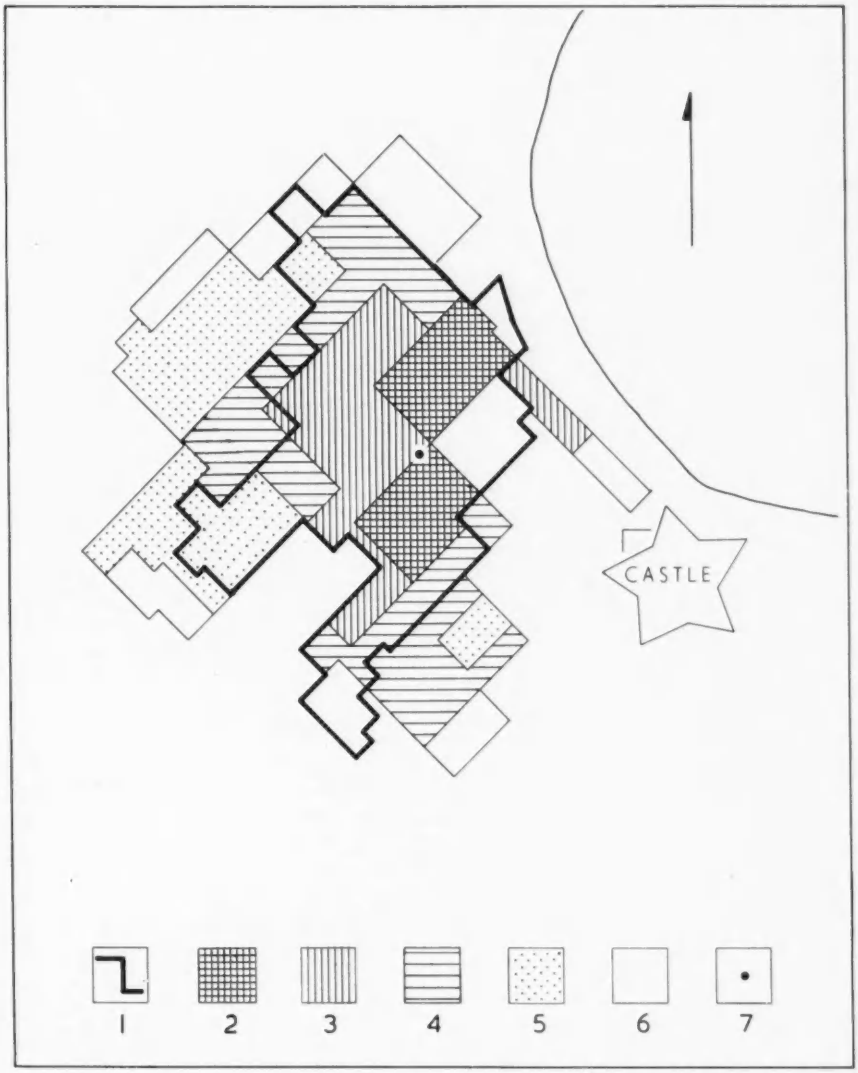

FIG. 13. The growth of Cape Town: 1693–1810. Numbers refer as follows: 1. CBD boundary; 2–6 inclusive refer to extent of built-up area by (2) 1693, (3) 1730, (4) 1767, (5) 1795, (6) 1810; 7. PLVI (1945 valuation).

Based on maps 51, 80, 89, 124, 125, and 215 in the Cape Archives. (Partly after Marshall) n.b. Owing to inadequacies in the source maps there are slight simplifications in the boundaries shown, and an exact scale has been omitted.

least since the yielding to pressure in the late nineteenth century which allowed slight encroachment onto the northwest end of the Parade.

Other Considerations

This paper is concerned only with the nature of the CBD boundary, but it may, in passing, be pointed out that the

effect of the restrictions discussed could be further demonstrated by a consideration of internal structure.[36] Both land use and land valuation show a marked asymmetry, with the peak blocks well over towards the southeast boundary, as indicated by the position of the PLVI in Figure 3 and other figures. In other words, the hard core is positioned asymmetrically within the CBD, as is evident from what has been said concerning block heights. Indeed, the PLVI—which was based on the valuation for 1945 and thus shows very well the situation before the Foreshore developments began to affect its location—must be very close indeed to that of early Cape Town. As the CBD itself has been unable to expand southeastward along its major outlets, so the PLVI has been unable to move in that direction. One may visualize its being drawn naturally eastward but held against the mass of barrier blocks—in terms of the previous analogy, like a cork carried on the ripples which break on that barrier. On the other hand, while the PLVI has been free to move northwestwards, it has shown no sign of doing so. Evidently, PLVI migration over the years was not influenced by mere freedom of movement, but could only have taken place towards the major outlets from the CBD. With these barred, it has remained essentially in the same place, as has the hard core around it. Only the CBD as a whole has expanded where it can, leaving the PLVI and hard core asymmetrically located within it, as it was itself left asymmetrically located by the growth of the total built-up area—but in the opposite direction.[37] With the construction of the new National Road from the northern end of Adderley Street across the Foreshore towards the hinterland, the PLVI may at last be expected to migrate—but northeastward towards the Foreshore.

[36] Information was recorded in the field in far more detail than was required for this paper, and with the study of internal structure in mind. This will be the subject of subsequent papers.

SOME CONCLUSIONS

Conclusions involve particularly the efficiency of the CBD and the effects of Foreshore developments.

The Efficiency of the CBD, and Its Problems

CBD efficiency is perhaps best examined in terms of internal structure, particularly the percentage of non-CBD activities present.[38] Even this limited boundary study, however, gives some indication of the essential inefficiency of Cape Town's CBD. In addition to economic and social problems beyond the scope of this paper, central Cape Town suffers from acute problems of vehicular and pedestrian traffic flow, which are aggravated by parking and commercial loading difficulties.

This is in part due to a historical change in the major direction of traffic movement. When the original street grid was laid, this was from the Company's Gardens to the harbor, so that the southwest to northeast streets were made wide—particularly where canals, or "grachts," were aligned along them. In contrast, the relatively unimportant cross streets were merely narrow lanes. With the growth of dependence on the hinterland, however, rail and, ultimately, motor traffic entered the CBD from the east via these cross streets, which have proved increasingly inadequate for the purpose. They are so

[37] Does the fact that the Hard Core has not expanded towards Signal Hill in the past, whereas the remainder of the CBD has, suggest a more clear cut distinction between the two than is generally accepted?

[38] See Raymond E. Murphy, J. E. Vance, Jr., and Bart. J. Epstein: "Internal Structure of the CBD," *Econ. Geog.*, Vol. 31, 1955, p. 24 *et seq.*

narrow and choked with pedestrians—some, within the hard core, have pavements less than six feet in width—that they have had to be declared one-way streets; even this limited traffic movement is choked by the presence of numerous commercial loading bays (Fig. 11). As a further consequence, street-parking facilities are woefully inadequate, which in turn adds to pedestrian congestion.

To add to the difficulties, the location of many of Cape Town's warehouses, wholesale establishments and small factories and workshops in the zone of urban blight northwest of the CBD forces much heavy traffic from the hinterland into these cross streets. A fair proportion of the great mass of commuters and shoppers from the eastern and southern suburbs have also to use these streets to reach the western parts of the CBD.

Ultimately, however, the trouble stems from a lack of foresight during the period of rapid expansion in the nineteenth century, when the barriers on the critical southeast side, instead of being in part removed to make room for suitable communications, were reinforced by the construction of the various administrative blocks in the public open spaces. These gradually spread, obliterating most of the possible parking areas shortly before the advent of the motor car made them essential, until only part of the Parade and one or two minor open spaces remain—all of them packed with parked cars shortly after 9 a.m. on a working day (Fig. 7).

The railway termini were particularly badly located in that they were built over the original extension of Strand Street, which was the only street of reasonable width which cut right across the CBD, linking the southern and Atlantic suburbs; their associated yards gradually usurped all the open space between them and the old shoreline (Fig. 8). In this way the already narrow entry for communications between the shoreline and Devils Peak was further restricted and is now, at rush hours, a complete bottleneck. Thus the CBD has become highly inconvenient and frustrating for the commuter, the shopper, and the tradesmen alike. The city has even paid for this short-sightedness aesthetically, for the over-tall central blocks, which hide the superb sweep of Table Mountain and its attendant peaks from many a street, and the lack of greenery in the CBD are partly the result of this congestion. Thus Cape Town today is, in appearance, an undistinguished city in one of the finest natural settings in the world.

But for the creation of the Foreshore there could be no real solution to these problems short of decentralization. Otherwise to allow for the continued growth which seems inevitable with the rapid growth of secondary industry, it would be necessary either to build a CBD of true skyscrapers or to remove some of the artificial restrictions. The first approach would ruin Cape Town irretrievably in the aesthetic sense, and could only aggravate the grievous traffic and parking problems, for it would do nothing towards clearing the main arteries from the east.

On the other hand, to remove the restrictions would appear quite impracticable. The Gardens must be considered sacrosanct by virtue of their historical associations, and also serve as the City's only "lung." In any case the main problems, as has been shown, do not lie in that direction. On the critical southeast side the railway yards were located on the flattest land between the 25-foot contour and the shoreline, and facing the Devils Peak gap through which the tracks must

pass—and near the shore at that; they could hardly have been re-located. The Parade has historical associations and, as the only sizable remnant of the old open expanses, serves a most useful purpose as the only large car park near the hard core. It is also backed by the thoroughly immovable Castle, standing four-square between the rail and road exits (Figs. 7 and 8). Finally, the cost of removing the administrative blocks would be prohibitive even if other sites were available, and they already require more space than is available to them.

In these circumstances it is hardly surprising that a good deal of decentralization was taking place before the Foreshore developments began to take effect. In the interwar years, for example, the University moved out to the southern suburbs, while, since the end of the second world war, a few retail stores have set up suburban branches and the headquarters of three large insurance companies have also left the central area.

Some Effects of the Foreshore Developments

It would be true to say, therefore, that but for the Foreshore, Cape Town's predicament would be essentially similar to that of many a rapidly growing western-type city. But the existence of the Foreshore has created opportunities to solve these problems which are surely unique. From 1938 to 1945 the huge Duncan Dock was dredged out from the shallow floor of Table Bay behind a protective mole, and the excavated material used to reclaim an area of the sea bed between the Dock and the old shoreline. In this way the Foreshore was created, providing Cape Town with almost 500 acres of dead flat land immediately adjacent to the CBD, eminently suited for the planning from scratch for the reorganization of the communications and the releasing of pressure within the CBD itself (Figs. 14 and 15). The entire development has been planned (and replanned!) in detail. With the railway termini and their yards being moved northward and eastward onto the Foreshore;[39] and new CBD blocks creeping northward along the outlet to the National Road, Cape Town has an opportunity to reorganize its CBD and escape the consequences of past mistakes; and this is very much in the minds of the authorities. Nevertheless, so far only a comparatively small number of the new Foreshore blocks have actually been erected, and many aspects of the scheme have long been disputed.[40] It is still possible that the unique opportunities will not be fully grasped.

One effect of these developments will inevitably be the elongation of the CBD northeastward, with associated migration of the geographic center and PLVI. It is likely that the 1957 land valuation, the results of which should soon be at hand, will show evidence of this trend; for there are already indications of it in the form of business premises standing empty around the southern sides of the CBD. The Foreshore, with its flat land, tall modern blocks, planned amenities—including parking facilities—and easy access to the hinterland via the National Road and the new railway termini, would appear to offer the best of the available retail and business sites, and a number of establishments from the present CBD are migrating there.

The Foreshore area is so large in relation to the CBD—it has approximately doubled the area available for business establishments—that it is difficult to

[39] At the time of writing (August, 1958) the Goods Station and yards were already functioning, while work was well advanced on the construction of the new passenger termini.

[40] See footnote 26.

FIG. 14 (left). A general view of the Foreshore looking northeast from the main Post Office roof (Fig. 6 and Block F11 in Fig. 5). In the foreground are the platforms of the present termini, beyond which those of the new passenger stations are under construction on earlier reclaimed land. In the middle distance a line of palm trees marks the 1938 shore, beyond which is the Foreshore proper with the new goods station at the extreme right. The Duncan Dock is in the background, with Table Bay beyond.

FIG. 15 (right). Another view of the 1938 shoreline as marked by the line of palm trees, looking southwest towards the lower slopes of Devils Peak.

foresee pressure on the old CBD boundary once it is fully occupied. Thus, although the removal of the present rail termini would theoretically permit the expansion of the CBD over a part of the present southeast boundary—where pressure is now greatest—such an expansion need not result to any marked extent. Indeed, the CBD is likely to become elongated about a northeast to southwest axis—i.e., at right angles to the shoreline as, it has been suggested, is usual for port cities.[41] Thus the size, shape, approaches, and even the building heights are changing—the latter owing to the imposition of rigid height controls on the Foreshore (Fig. 10)—as the CBD creeps onto the Foreshore and pressure is released.

Very few other cities in the world can hope to enjoy Cape Town's opportunities for reorganizing her CBD. With these opportunities present there is, perhaps, no practical reason for seeking a method of relieving the pressure within the CBD, and thus no means of telling whether the type of approach attempted here can assist in such a search. Possibly, however, it may have some application in other cities, and it should prove capable of further development. The study of one city can never be made the basis for drawing conclusions on CBDs in general, much less for formulating any theories. But if the CBD boundaries of other cities are examined along these general lines useful comparisons may perhaps be possible, from which general theories may be evolved.

[41] Murphy and Vance: "A Comparative Study of Nine Central Business Districts," *op. cit.*, p. 314, and caption of Fig. 10.

ACKNOWLEDGMENTS

The author wishes to acknowledge his indebtedness to the South African National Council for Social Research for financial assistance, without which this work would have been impossible. He also wishes to express his gratitude to the City Engineer of Cape Town for providing access to information, and also to a number of officials in the City Engineer's Department, Municipality of Cape Town, and Professor W. J. Talbot of the Geography Department, University of Cape Town, for advice and helpful comments.

Note: A second article on the CBD by Davies, this one dealing with problems of delimiting Cape Town's hard core, will appear in the January, 1960 issue of this magazine.—The Editor.

VON THUNEN IN RETROSPECT

Andreas Grotewold

Dr. Grotewold grew up in northeastern Germany not far from the place where von Thünen developed his theory. He is now Assistant Professor of Geography at the University of Missouri.

THIS paper is a critical analysis of von Thünen's theory of the location of agricultural production. It is essentially a defense of that theory against false interpretations and unjust criticism in recent decades. My analysis of von Thünen's theory bears some relation to recent methodological writings in American geographic journals. Thus, the introduction presents some comments on such writings; and the conclusions deal with those aspects of von Thünen's theory which may have a bearing upon the views expressed in them.

Introduction

An economic geographer reviewing recent methodological papers in American journals can hardly fail to be impressed with the large number of articles suggesting that he devote more of his ingenuity to the formulation of theories and laws. In some instances the authors express dissatisfaction with the empirical and descriptive research conducted by economic geographers in the past and at present.[1] One must agree that the abundant descriptive material accumulated thus far is so diversified that it is difficult to relate many individual studies to any general lines of investigation. The present writer knows of only one book which successfully integrates a consistent series of empirical, microgeographic studies into a pattern of continental dimensions and shows the method by which this was accomplished. This is Professor Platt's book on Latin America;[2] in the opinion of this writer, his achievement is practically unique.

A greater effort by economic geographers to generalize the results of their detailed studies might indeed result in a better appreciation and understanding of large, significant patterns. But such efforts would not necessarily result in the creation of theories and laws. Generalizations are derived from observed facts and coincidences. For example, to say that a large proportion of Americans prefer to live in one-family suburban residences rather than in apartment houses near the center of the city is to make a valid generalization. Theories are something different. They consist of propositions which if applied to specific phenomena explain their existence or characteristics. A "proposition" as the term is used throughout this paper may be any statement which within the framework of a theory is considered to be true; actually such propositions may be factual, presupposed, or assumed.

In Burgess' well-known concentric zone theory, for example, one of the

[1] Maurice B. Ballabon: "Putting the 'Economic' into Economic Geography," *Econ. Geog.*, Vol. 33, 1957, pp. 217–223; John Q. Stewart and William Warntz: "Macrogeography and Social Science," *Geogr. Rev.*, Vol. 48, 1958, pp. 167–184.

[2] Robert S. Platt: *Latin America: Countrysides and United Regions*, New York, 1942.

propositions is the generalization mentioned above;[3] cities are the phenomena to which his propositions are applied; and what is explained is the formation of concentric rings of urban land use and expansion. Laws, if derived from theories, state the consequences which ensue from the propositions and their application. Thus, Burgess' law is that in American cities land use and urban growth take the form of concentric zones. A theory is applicable only if its propositions are applicable. Burgess' theory, for example, would not be applicable if nearly all Americans preferred to live in apartment dwellings near the center of the city.

Most geographers are acquainted with various theories which they accept as useful. So far most of them have been formulated by scientists in other fields. But if the trend heralded by our recent methodological writings bears fruit we may soon have more and better theories by geographers. Yet the present writer would not wish the empirical, micro-geographic approach discarded or forgotten. He believes that facts actually observed and generalizations derived from them are likely to be more valid than theories, because they do not rest upon propositions and therefore their relevance to reality cannot be doubted. Besides, he just cannot understand why it should be the aim of all science to establish theories and laws. The term "science" is derived from the Latin word *scire* which means "to know." Presumably the aim is to know the truth. Just why must theories yield more or better truths than an unbiased and thorough analysis of empirical data?

Even he who follows the traditional approach of gathering and analyzing empirical facts may find it necessary to concern himself with theories. The reason for his concern may be the desire to convince his theory-minded colleagues that conclusions based upon field studies and other empirical evidence are truthful and valid even though they do not conform to any one of the existing theories, or to a combination of them, and do not necessarily lead to the formulation of new theories and laws.

The present writer found himself in such a position. While dealing with recent changes in land use and agricultural production near Kansas City and St. Louis he noticed a general decline in the cultivation of perishable and bulky commodities and a decline in intensive types of farming. This situation was not unique; the Chicago area showed basically the same trends. According to the censuses of 1950 and 1954 the commercial vegetable acreage had decreased in the standard metropolitan areas of each of these three cities; so had the area used for the production of flowers in the open and under glass.[4] Such trends are contrary to the common interpretation of von Thünen's theory. The writer had heard and read repeatedly that, according to von Thünen, farmers near the market must use their land intensively and produce commodities which are perishable, yield a great bulk per acre, and require high transportation costs relative to their value; whereas farmers at a greater distance from the market must use their land less intensively and produce less

[3] H. H. McCarty: "An Approach to a Theory of Economic Geography," *Econ. Geog.*, Vol. 30, 1954, pp. 95–101, explains how generalizations may become propositions of theories.

[4] U. S. Bureau of the Census: *United States Census of Agriculture: 1954*, Vol. I, Parts 4, 5, 10, and 13, Washington, 1956, County Tables 8 and 9. The Standard Metropolitan Area of Chicago included Cook, Lake, Kane, DuPage, and Will Counties in Illinois, and Lake County in Indiana; that of St. Louis included St. Louis and St. Charles Counties, and the City of St. Louis in Missouri, and Madison and St. Clair Counties in Illinois; that of Kansas City included Jackson and Clay Counties in Missouri, and Wyandotte and Johnson Counties in Kansas.

perishable and bulky commodities. The following analysis of von Thünen's theory was made to discover the reason for the obvious discrepancy between the theory and the recent trends in urban-fringe farming mentioned above.

THE THEORY

Johann Heinrich von Thünen lived in Germany from 1783 until 1850. He contributed to modern science the first theory of the location of agricultural production.[5] His interest in the economics of agriculture had been inspired by the study of such earlier economists as Adam Smith and Albrecht Thaer. At the age of 27 von Thünen acquired the estate "Tellow" near Rostock in Mecklenburg which he operated for 40 years until his death. Most of the data used in explaining and amplifying his theory were obtained by him through practical experience, including detailed cost accounting, on that estate.

According to von Thünen's own appraisal of his work his most important achievement is the concept of the *isolierte Staat*. This is the idea of an "isolated state" in which there is only one central city, the market, and around it an extensive plain of tillable land, uniform in its physical characteristics, served by only one mode of transportation, and inhabited by farmers supplying the central city and having no difficulty in adjusting the use of their resources to any economic condition that might evolve. Thus, several factors normally contributing to a considerable regional diversity of land uses and agricultural production were assumed to be constant or nonexistent.

Land Rent

Within the setting of the *isolierte Staat* von Thünen considered the relationship among (1) distance of farms from the market, (2) prices received by farmers for their products, and (3) land rent.

The relationship between the first two factors was very simple. The price which a farmer obtained for a given unit of commodity was equal to its price at the market minus the cost of shipping it to the market. The cost of transportation increased with distance from the market. Thus, any given product—a bushel of rye, for example—represented a greater value to a farmer living within two miles of the market than to a farmer living at a distance of 20 miles.

The third factor, land rent, was defined as the return from the investment in the land.[6] In the *isolierte Staat* land rent depended upon location relative to the market. This can be explained most easily by a history of settlement. When the *isolierte Staat* was small, only a little land around the city was needed to supply it with agricultural products. As settlement expanded and the demand for agricultural products increased, land at a greater distance had to be taken under cultivation. As a result of the increased cost of shipping from this outer zone to the city, market prices for agricultural products had to increase. Farmers in the earlier settled area benefited from such higher prices. Compared to farmers in the more recently settled, outer zone they obtained the differential advantage of lower transportation costs to the market; thus their land provided a rent and increased in desirability and value. Eventually, settlement expanded still further and a third zone, even more remote from the

[5] His complete works are contained in Johann Heinrich von Thünen: *Der Isolirte Staat in Beziehung auf Landwirtschaft und Nationalökonomie*, 3rd ed., Berlin, 1875. This book consists of three parts. An earlier edition of Part I had appeared in 1826.

[6] The following discussion of land rent is not paraphrased directly after von Thünen's book. But the definitions given are synonymous with von Thünen's. See *ibid.*, Part I, pp. 14–16, 227–229, and 350–353.

city, was taken under cultivation. At this stage prices for agricultural products in the city had to increase even further. Consequently, the second zone of settlement began to provide a land rent, and in the first settled area the rent increased.

The formula given below indicates how land rent for any one product can be derived:

$$R = Yp - E - Yfk.$$

In this formula, R = land rent per acre; E = production expenses per acre, including labor, supplies, and equipment; Y = yield in units of commodity per acre; p = market price per unit of commodity; f = freight rate, i.e., the cost of shipping a unit of commodity over the distance of one mile; and k = number of miles from the market.

The value of land was determined by the rent it yielded. Land nearest the city was most valuable because it yielded the highest rent; land near the outer limit of cultivation was of little value because it yielded a low rent.

Agricultural Production

Within the *isolierte Staat* areal differences in land use and agricultural production were the result of three forces. These were (1) the types and quantities of agricultural products needed in the city, (2) the technology employed in the production and transportation of such commodities, and (3) the endeavor of each farmer to maximize his land rent by producing commodities for which the location of his land relative to the market offered the greatest advantage. These three forces created the pattern of land uses shown in Figure 1A.[7] The following is an interpretation of this pattern.

It has already been mentioned that von Thünen relied upon empirical information in defining the commodities needed in the central city and in calculating for such commodities the production expenses, yields, and market prices. His model of the *isolierte Staat* reflects the needs of Rostock city dwellers and the state of technology in Mecklenburg well over a hundred years ago. Writers who have since described von Thünen's theory or elaborated upon it have frequently overlooked these circumstances, and such neglect has resulted in false interpretations and unjust criticism of his theory. Naturally, von Thünen took the conditions of his time for granted. Today, however, such conditions must be stated as definite propositions of his theory. One of these is that in the *isolierte Staat* there was only one form of transportation, the horse and wagon, operated by the farmer at his own expense. There were no multiple freight rates depending upon the commodities shipped. Refrigeration in transit had not yet been invented.

Under such conditions the land nearest the city was used for the production of fresh milk and vegetables. Here cattle were kept in stables throughout the year. The fertility of the land was maintained through manuring, and if necessary additional manure was bought from teamsters in the city. The reason for the existence of this zone so close to the city is to be found in the state of technology. The slow speed of transportation and the absence of refrigeration made it impossible, or at least precarious, to ship fresh milk and vegetables over greater distances. In the location of this particular zone the cost of transportation was not a pertinent consideration. Since fresh milk and vegetables were required in the city, prices for them

[7] Figure 1 was copied from *ibid.*, Part I, pp. 390 and 391. Some of the terms used by von Thünen to describe types of farming have no equivalent in the English language. An attempt had been made to translate their meaning as closely as possible.

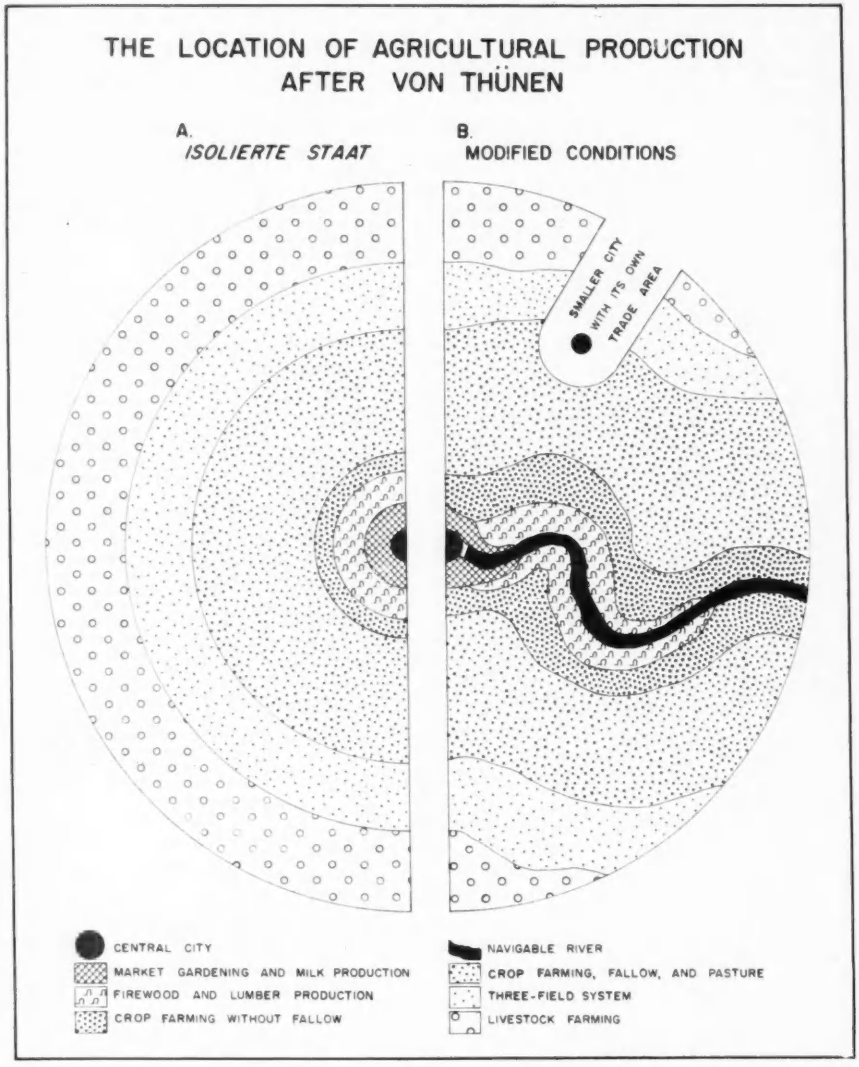

FIG. 1.

had to be so high that no other use of the land would have yielded a higher rent.[8]

The second belt was used for the production of wood. Von Thünen has shown, on the basis of his empirical data, that forestry yielded a higher rent on this land than any other use. The following is a simplified version of his argument.[9]

Forest land produced not only lumber but, more important, it was the source

[8] *Ibid.*, Part I, p. 3.

[9] *Ibid.*, Part I, pp. 172–184.

of firewood required in the city. The physical volume of all wood obtained from an acre was quite large; let us assume that it was three times as large as that from an acre of product D. In addition, let us assume that for each commodity the production expenses and yields were the same in all parts of the *isolierte Staat*.

Figure 2 illustrates the competition for the land between wood (thick lines) and product D (thin lines). The dashed lines (*Yp*) represent the prices of produce per acre at the market. The dotted lines (*E*) show the production expenses per acre. The solid lines (*Yp-Yfk*) represent the market prices of produce per acre minus the cost of shipping them to the market, i.e., the per acre values of the respective commodities at the site where they were produced. Obviously, these values decreased with distance from the market. In our example the rate of decrease per unit of distance was three times as great for wood as for product D. All land owners in the *isolierte Staat* selected the land use which would give them the highest land rent (*R*). Figure 2 shows that wood yielded a greater rent up to the distance of k_2; beyond that the rent was higher for product D. Thus, wood was produced closer to the market than product D.

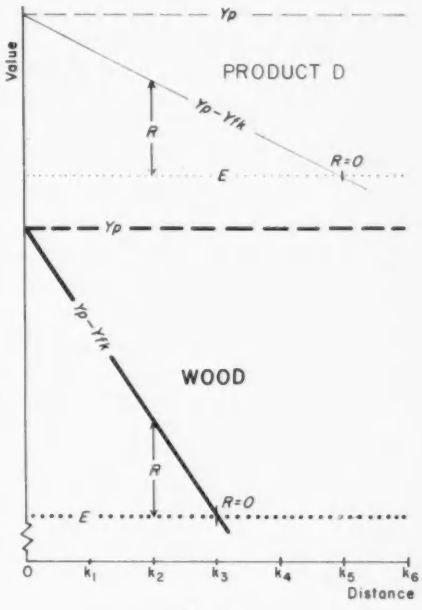

FIG. 2.

Some authors have stated as a general law that, according to von Thünen, the product with the higher yield per acre must be produced closer to the market. Von Thünen had indeed arrived at this conclusion and stated it in his book.[10] But it is misleading to repeat this statement outside its proper context. It held true only if the competing commodities were equally resistant to spoilage and if the higher cost of shipping the more bulky product could not be compensated by lower freight rates or by a reduction in the production expenses.

According to von Thünen the production expenses for wood were fairly equal in all parts of the *isolierte Staat*. This, however, was not so for all commodities. His model of the *isolierte Staat* (Figure 1A) shows behind the forest belt three zones where rye was an important market product. The essential difference among these three zones was in the intensity of cultivation. With increasing distance from the market the production expenses for rye were lowered with a consequent reduction in yields.

In the first of the three zones farmers followed a six-year crop rotation. Rye occupied one-third of the land; the other two-thirds were planted to potatoes, barley, clover, and vetch.[11] Potatoes,

[10] *Ibid.*, Part I, p. 2.

[11] *Ibid.*, Part I, p. 90.

like rye, were sold in the city. Vetch was used as a soil builder and for green fodder during the summer. Cattle were kept in stables most of their lives. The soil fertility was maintained through manuring. There was no fallow land.

In the next zone the land was used somewhat less intensively. Farmers applied a seven-year crop rotation wherein rye occupied only one-seventh of the land; it was followed by one year of barley, one year of oats, three years of pasture, and one year of fallow.[12] The market products consisted of rye, butter, cheese, and possibly live animals to be slaughtered in the city. Such products did not spoil as quickly as fresh milk and vegetables and could be produced at a considerably greater distance from the market.

In the most distant of the three rye-supplying zones farmers followed the three-field system. This was a rotation scheme wherein roughly one-third of the land was used for field crops, another third for pasture, and the remainder left fallow.

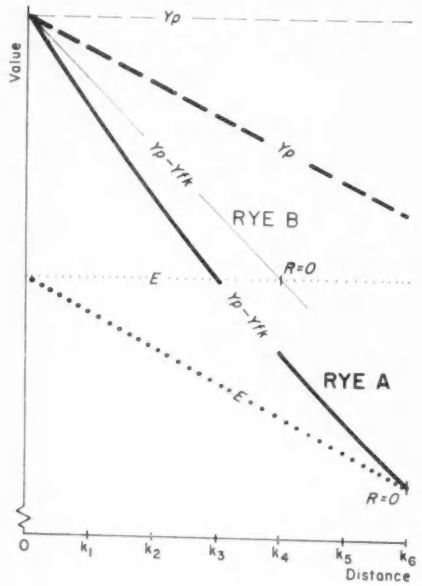

FIG. 3.

Beyond this zone, in the area of livestock farming, the distance to the market was so great that even the most extensive and cost-saving method of rye production could not have yielded a higher rent than the production of butter, cheese, or live animals. Consequently, the production of rye was limited to the demand on the farm. Only animal products were marketed.

Figure 3 illustrates the effect of decreasing production expenses and yields upon the areal extent of rye cultivation. Rye A (thick lines) represents rye cultivation as it was described by von Thünen; production expenses and yields decreased with increasing distance from the market. Rye B (thin lines) is a hypothetical projection of rye cultivation as it was carried on near the market into areas at some distance from the market. At the market the rent for rye A and rye B was the same. From there outward, however, the rent decreased less steeply for rye A than for rye B. At the distance of k_4 the rent for rye B would have been zero whereas for rye A it was still positive. Thus, through less intensive cultivation the rent which rye yielded at greater distances from the market was increased, and rye could compete with other products over a wider area.

On the basis of this argument some writers have stated as a general law that, according to von Thünen, the intensity of cultivation must decrease with increasing distance from the market. Such statements are very irritating if quoted outside their proper context. As is shown in Figure 2, the production expenses for wood were far lower than for product D. Yet wood, the less intensively cultivated product, was

[12] *Ibid.*, Part I, p. 89.

grown closer to the market than product D. Even in the case of a single product, such as rye, this law is subject to an important qualification. A reduction in the production expenses is feasible only if the consequent reduction in yields is not so great as to offset the savings accomplished by the reduction in production expenses.

It has been recognized, by von Thünen and others, that the conditions of the *isolierte Staat* were nowhere duplicated in practice. In von Thünen's book one finds a diagram showing the application of his principles to an area traversed by a navigable river where transportation was more speedy and shipping costs only one-tenth as much as on land (Figure 1B). As a practical farmer von Thünen was aware also of areal differences in the productivity of the land and of the fact that farmers differed in ability to manage their land so as to obtain the highest land rent possible. Such facts modified the simple model of the *isolierte Staat*; but they did not invalidate von Thünen's basic principles.

CONCLUSIONS

The preceding discussion permits the following conclusions regarding von Thünen's theory:

(1) The theory was based upon propositions. Some of these were empirical facts which von Thünen had observed; other propositions were taken for granted or stated as assumptions.

(2) The importance of the empirical background and the propositions derived from it have been overlooked by many writers who have quoted or interpreted von Thünen's theory.

(3) A modern reader cannot understand von Thünen's theory unless he considers its empirical background. The present writer, who had done so, found it consistent and logical.

Von Thünen's theory was applicable during his lifetime and for many years beyond. The patterns of land uses near European and American cities conformed quite closely to the model of the *isolierte Staat*, and the theory offered a sound explanation for the forces which had shaped such patterns. Even today there are still bits of evidence for von Thünen's theory near cities in Europe and America. The evidence, however, is vanishing.

What has upset von Thünen's theory more than anything else is the development of modern transportation. Lake steamers, river barges, railroads, and even trucks are vastly cheaper means of transportation than the horse and buggy. No longer are the costs of shipping strictly proportional to bulk and distance; much depends upon the means of transport and the commodities shipped. Perishable commodities are moved long distances under refrigeration. Surely, urban-fringe farmers still benefit from lower transportation costs to the market for many products. But the importance of their locational advantage has declined to the point where they cannot compete with distant producers who are favored by better land, cheaper labor, or lower taxes.

Other reasons for the obsolescence of von Thünen's theory are changes in the tastes and demands of city dwellers, made possible by modern technology. Firewood, for example, is no longer an important fuel. Improvements in transportation and the arts of canning, cold storage, and freezing have greatly increased the variety of foods available to consumers. In von Thünen's time people ate lettuce in spring, tomatoes in summer, apples in fall, and sauerkraut in winter. Today, they can select what they like best or what fits their prescribed diet, and this they eat pretty much throughout the year. By and

large the choices made by consumers have not helped the urban-fringe farmer. Many of the desired products, like bananas and citrus fruit, he cannot grow at all. Others, like tomatoes or lettuce, he can supply only for a few months of the year. For example, of the total quantity of lettuce unloaded in St. Louis in 1956 less than three per cent came from Missouri and Illinois; 82 per cent originated in California and Arizona.[13] Of the fresh tomatoes 33 per cent came from Missouri and Illinois; during the month of July these two states supplied 88 per cent, whereas during the winter nearly all the fresh tomatoes came from Florida.

The flow of dairy products in Missouri is a fine example of the decreasing significance of transportation costs. The city of Columbia, about halfway between Kansas City and St. Louis, has two dairies. These face competition from larger enterprises just outside Kansas City. The latter buy fresh milk from farmers within a few miles of Columbia.[14] From here the milk is shipped nearly 130 miles to Kansas City where it is pasteurized and homogenized; the final product is then shipped back to Columbia where it is sold. An even more striking example is the flow of half-and-half cream and chocolate drinks. A dairy located in the St. Louis area buys its milk from places in the Ozarks which are at least a hundred miles closer to Kansas City. In St. Louis the milk is made into cream and chocolate drinks. These products are shipped about 250 miles to a branch plant in Kansas City from where they are distributed to Columbia.[15]

[13] U. S. Agricultural Marketing Service: *St. Louis, Unloads of Fresh Fruits and Vegetables: 1956* (mimeographed, no date).

[14] Edward L. St. Clair: *Marketing Administrator, Greater Kansas City Marketing Area Bulletin*, Vol. I, No. 5, February 1958, p. 1.

For purposes of farming the urban-fringe areas of American cities have lost much of their high rent-yielding potential. High land values in such areas must be attributed primarily to suburban expansion and to the real estate boom that goes along with it.

Obviously, an explanation of recent trends or a forecast of future developments in urban-fringe farming on the basis of von Thünen's theory could hardly come close to an approximation of reality. The reason for the obsolescence of von Thünen's theory is not to be found in any logical error committed by him. Nor is it that better information has become available since he formulated his theory. Von Thünen's theory is outdated as far as urban-fringe farming is concerned because his propositions regarding the production, transportation, and consumption of agricultural commodities are no longer applicable. Otherwise, there is nothing faulty in the theory.

In commenting on this paper Professor Murdock of the University of Missouri suggested that by substituting for perishable agricultural commodities such "perishables" as services one might find that the basic principles of von Thünen's theory hold true even at this time. This interesting possibility appears to be a promising research topic in urban geography. If it should show positive results it would, in the opinion of this writer, create a new theory. Such theory would be "new" because it would be based upon a new set of propositions (pertaining to the city-dweller's need for services) applied to new phenomena (urban instead of agricultural land) and explain different characteristics of such phe-

[15] Information from Mr. Stephen F. Whitted, Agricultural Economist at the University of Missouri.

nomena (presumably a concentric zone arrangement of service industries).

However stimulating von Thünen's thoughts might be, the fact remains that his theory of the location of agricultural production as presented nearly a century and a half ago is now outdated. Von Thünen's propositions were concerned with man and the creations of man, and these are likely to change. All theories in the social sciences are subject to this limitation. No "law" of economics, economic geography, or any other social science can ever be a "law" in the sense in which the mathematician or physicist is permitted to use the term.

This, of course, does not imply that theories and laws in the social sciences are useless. It merely means that they must be considered within their historical and regional settings. The latter are recorded in the form of empirical, microgeographic observations and facts. Such facts can never be insignificant, sterile, or fail to meet the needs of economic geography; on the contrary, they are the basic stuff on which all valid theories must be founded and against which the theories must be evaluated. But, of course, even the best descriptions of empirical observations and facts are useless to him who denounces them as insignificant. A disregard for empirical information is not a recommendation for a scholarly paper in economics, economic geography, or any other social science, whether the purpose is to evaluate the works of previous writers or to arrive at new generalizations or theories.

ACKNOWLEDGMENTS

This paper originated in connection with a study of regional changes in the size of farms in Missouri supported by a University of Missouri Research Fellowship during the summer of 1957. I am indebted to the following persons for helpful criticism and comments: Dr. A. C. Benjamin, John H. Lathrop Professor of Philosophy; Dr. John C. Murdock, Associate Professor of Economics; and Dr. Jesse H. Wheeler, Jr., Associate Professor of Geography, all at the University of Missouri. The opinions expressed in this paper are, of course, the sole responsibility of the writer.

SUGAR GROWING AND PROCESSING IN THE UNION OF SOUTH AFRICA

Owen Williams

Dr. Williams is Senior Lecturer in Geography at the University of Natal.

THE sugar industry is one of the oldest, most important and most highly organized industries in Natal, and employs in field and factory as many as 3300 Europeans, 6500 Asiatics, and 58,500 Natives.[1] The Natal coast, with a recent extension into the southeastern Transvaal, is the Union's only sugar-growing area, and although only about 3 per cent of the world's cane is grown in this belt its importance to southern Africa is immense. The industry has grown rapidly as a result of the increasing consumption of sugar consequent upon rising standards of living.

Sugar Growing

While various indigenous grasses resembling sugar cane grew along the Natal coast, the first true cane was imported from Réunion, and was planted at Compensation some 30 miles north of Durban. From this cane, reaped and processed into sugar by 1852, developed the first permanent, large-scale cash crop of the province, and an industry which has since provided much of the capital for the economic development of Natal. Up to that time the coast line had been unexploited, apart from small-scale cultivation of maize, vegetables, sub-tropical fruits, and export crops like arrowroot, indigo, coffee, and tea; stock rearing was limited by climate and diseases. Sugar growing effectively eliminated such experiments, and in fact has largely prevented their subsequent reappearance.

From this area just north of Durban sugar growing spread rapidly and with increasing intensity first along the south coast, and later along the north coast,[2] as indicated in Figure 1. The spread was aided by certain factors, and hindered by others.

Perhaps the earliest difficulty was shortage of labor, for the Natives of the coast showed little inclination for plantation work. This difficulty became critical in the 'fifties, and in order to overcome it the first Indian immigrants were encouraged to settle in Natal in 1860. Since most preferred to remain as free settlers at the expiration of their indenture periods they had to be continually replaced until immigration virtually ceased in 1911. Nevertheless, "from that day [in 1860] began the material prosperity of Natal."[3] By 1888 six thousand Indians were employed in the sugar industry, as compared with 2500 Natives; and the area under cane had increased from 3153 acres in 1859 to 7443 in 1861. This early expansion occurred in the face of formidable obstacles. Communications with the markets at and beyond Durban depended upon ox and horse transport

[1] *Official Yearbook of the Union of South Africa*, 1954–1955.

[2] The terms north and south coasts refer locally to those areas north and south of the port of Durban.

[3] C. J. Ferguson-Davie: *The Early History of Indians in Natal*, South African Institute of Race Relations, Johannesburg, 1951, p. 14.

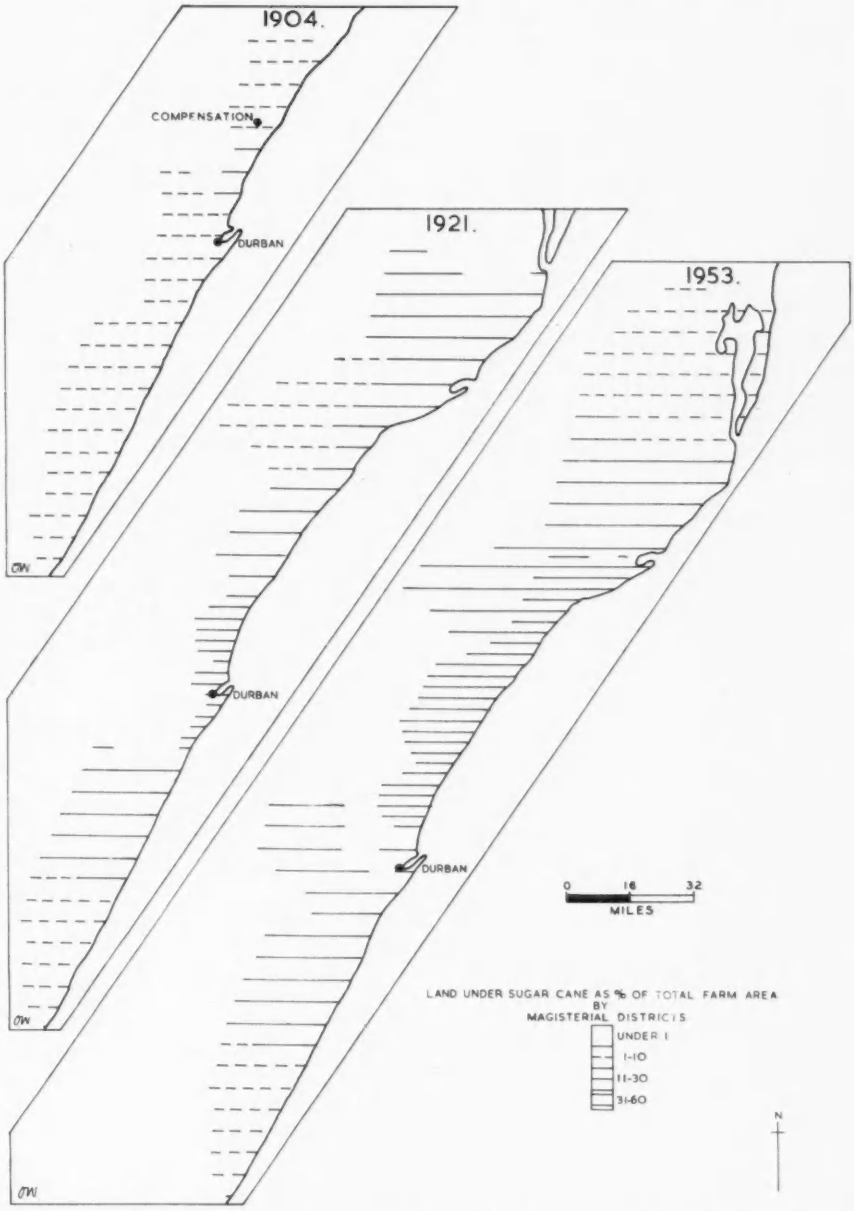

FIG. 1. The sugar belt, Union of South Africa, in 1904, 1921, and 1953. (Sources: Census of Colony of Natal, 1904; Union Agricultural Census, 1921, 1952–1953.)

over poor roads and through low-lying lands subject to disease and floods. In response to increasing demands for sugar by the urban populations which grew up as a result of the discoveries of diamonds and gold in the Cape and Transvaal, railways were built from Durban along both the north and south coasts by 1910.

In the meantime the cane itself was proving unsatisfactory, and but for the introduction of the Uba variety from India in 1883, it is very doubtful whether the industry would have survived. This cane was the standard type used until 1930, when others which gave higher glucose content, easier milling conditions, and higher resistance to disease were imported or developed. The change which has since taken place is evident when one considers that 99.96 per cent of the cane of the sugar belt was Uba in 1932 but by 1958 other varieties, notably N:Co 310, had completely replaced it.[4]

A further impetus was given to the spread of cane growing by the acquisition of assured markets as a result of a customs agreement negotiated between the various South African colonies in 1903; competition from Mauritius, which had contributed in so many ways to the early growth of the industry, was largely eliminated. Similar advantages were to accrue in more recent times from the Commonwealth Sugar Agreement of 1951, and from the International Sugar Agreement of 1954.

After the Native Reserves and Crown Lands of Zululand had been demarcated by the Lands Delimitation Commission of 1902–1904, that country, lying north of the Tugela River, was opened to European settlement in 1905; the land available, perhaps the best in Zululand, was located along the railway line from the Tugela to Empangeni. By 1908 one hundred and four farms had been allotted, and 6500 acres were under sugar cane. The farms were given to individual settlers, and are still the smallest ones in the sugar belt.

By 1921 the cultivation of Uba had virtually reached its limit under dry-land conditions. From that date the increase in area and intensity of cane growing has been due to the use of irrigation (Fig. 2), coupled with the introduction of new varieties. Restricted areas are watered at a number of estates, both by furrow and overhead spray irrigation; the latter method is generally considered to be most suited to Natal conditions, and its cane yields are three or four times as much as those of unirrigated lands. The most recent and significant development, however, has taken place on the north bank of the Pongola, although a number of irrigated plots also exist on the Natal side of the river. The cane is grown at the Pongola Settlement, under furrow irrigation from a large dam, although spray irrigation has recently been introduced. After cotton growing had started under great difficulties on the Natal side of the river in 1912, an irrigation scheme for growing food crops was completed on the Transvaal side in 1935. As a result of the incidence of malaria it was difficult to find settlers, but in 1944 a Commission of Enquiry first suggested large-scale sugar growing. Representatives of the sugar industry gave as their opinion that it would be uneconomical to extend sugar growing into the area; the cane would either have to be sent by road and rail to the nearest existing sugar mill at Riverview near Mtubatuba, or a mill would have to be erected on the spot. Nevertheless, the cultivation of sugar was encouraged, and part of the cost of transport to Riverview was paid by the sugar indus-

[4] *South African Sugar Yearbook*, 1956–1957.

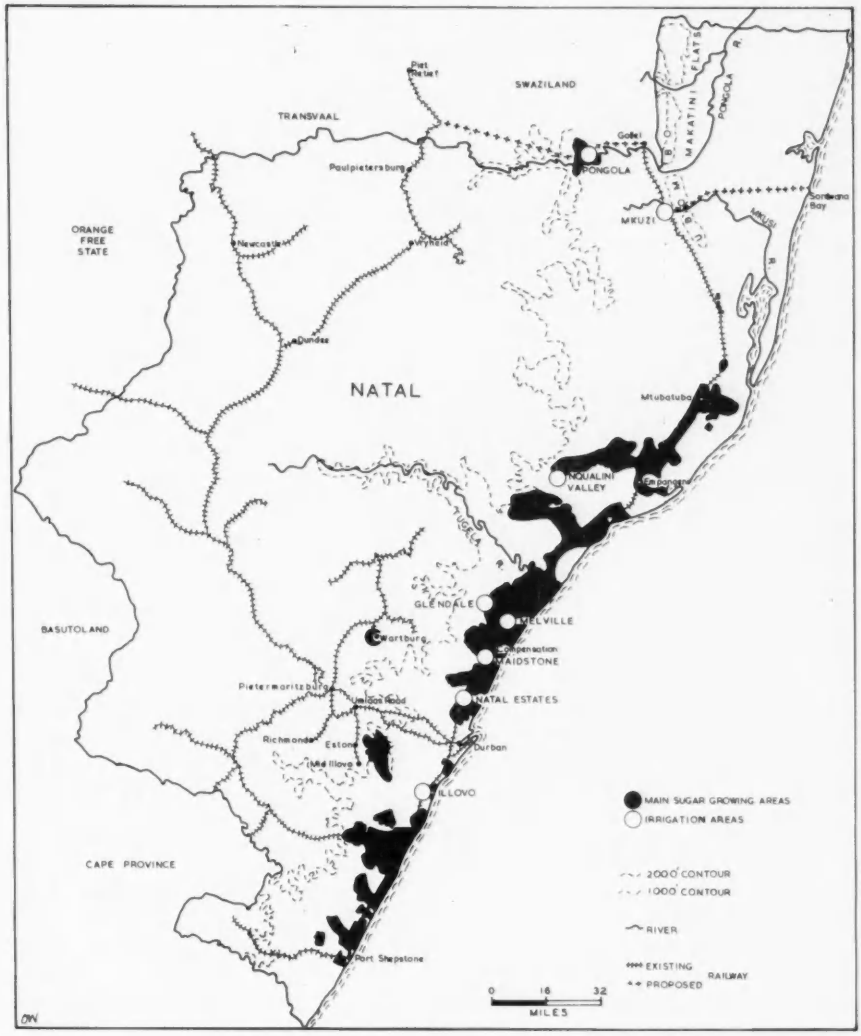

FIG. 2. Sugar growing in Union of South Africa. (Sources: Agricultural Census, 1953–1954; field work; and S. A. Sugar Yearbook, 1956–1957.)

try. In 1950 the government announced that the whole of the settlement would be put under cane, that a mill would be built, and that roads would be constructed to connect the settlement to the railhead at Gollel, and to Piet Retief (Fig. 2). With increasing prices for sugar, and an already assured demand at home, it was felt, after the Commonwealth Sugar Agreement of 1951, that the proposition was economically sound, and it was decided to move a sugar mill from Esperanza on the south

coast, piece by piece, to the Pongola. The milling of the cane of the area began in 1954.

Since 1930 the use of new varieties has engendered another extension of cane growing, this time into areas of higher altitude south of Mtubatuba. The new types, apart from rendering increased yields, have been specifically developed to withstand the long, cold winter of the coast and the more extreme conditions further inland. It is these varieties which are grown in the Wartburg, Eston, Richmond, Mid Illovo, and Umlaas Road areas.

The present area under sugar is a well-marked narrow belt set within the coastal magisterial districts from the extreme south of Natal to Mtubatuba (Fig. 2) and extending inland normally to about 2000 feet elevation and exceptionally to 2500; a few minor areas of cultivation, as at Mkuzi, extend it to the recently-established fields near the Pongola. In the north near Mtubatuba, dry land cultivation is limited by lack of rainfall; in the south it is limited by low temperatures, the absence of railway communications, and the presence of extensive Native reserves in adjacent areas of the Cape Province; in the interior it is limited both by the presence of Native reserves, and by low temperatures.

FIG. 3. Sugar processing in Union of South Africa. (Based on field work.)

The belt can only be described as marginal, in relation to the requirements of large-scale sugar cultivation. The industry survives and prospers partly as a result of the needs of its local markets and partly as a result of quotas available for export, but mainly because of the imposition of quite heavy duties upon sugar imports. Ideal conditions for optimum yields of sugar cane may be summarized[5] as the presence of a minimum of 50 to 65 inches of rainfall per annum, the occurrence of periods of bright sunshine within the rainy season, and the existence of temperatures of over 70° F. during the growing season. The first and last conditions scarcely apply to Natal. New strains may well be able to withstand lower temperatures, but the relatively low rainfall along the coast is rather more of a problem. It has been estimated that only about a third of the existing area under cane can be irrigated, and then only in restricted local areas, because of the presence of intermittent rivers flowing in low-lying valleys through rolling countryside. These conditions also make for slow mechanization, but

[5] *Oxford Economic Atlas*, Oxford University Press, 1954.

on the other hand the area is singularly free from disease and pests, and has a long harvesting season in comparison with the main world sugar-growing areas which occur at lower latitudes. At all events, the best farming areas of Natal support a sugar cane monoculture; 93 per cent of many farmers' incomes is derived from this crop.[6]

Future extensions of the cane belt are likely to take place in the higher-altitude regions of the interior, in the Native areas (where however sugar growing is generally declining at present), and by the use of irrigation, between Mtubatuba and the Pongola. The last area, by virtue of its relatively flat land, its more northerly location, and its virgin state, seems most promising, as Table I suggests:[7]

TABLE I

ACREAGE UNDER CANE

	1923	*1949*	*% increase*
Natal	141,000	226,968	60.5
Zululand	70,000	131,268	87.5

1953–1954 yields[8] confirm this suggestion. The yield of cane in tons per acre of cane cultivated was 20.99 along the south coast, 31.13 along the north coast, 30.60 in Zululand, and averaged 28.75 for the whole belt. Hlabisa, the most northerly district which may be said to lie within the sugar belt, had in fact the highest yield. In addition to the above areas, however, future developments in the Pongola region may well result in the opening up of a whole series of more remote cane-growing areas, not only in the low veld at the junction of the Transvaal, Natal, and Swaziland, but east of the Ubombo Range in the Makatini Flats area (Fig. 2). This will depend not only upon the success of cane growing at Pongola, but upon the building of a dam at Pongola Poort, and the construction of a railway from the Piet Retief-Paulpietersburg line through Pongola to Gollel, and thence through Mkuzi Poort to Sordwana Bay. While sugar growing may thus be of great significance in these areas, far more important considerations are at stake, for an alternative port to Durban would then be available for the Transvaal.

In conclusion it may be noted that cane growing is essentially carried out by Europeans (Table II).[9]

SUGAR PROCESSING

Figure 3 indicates the distribution of the present sugar mills and their associated industries. They sprang from the first hand-operated mill at Compensation, and spread in complete accordance with the extension of sugar growing. At first the spread was extremely rapid, because of the need for quick transport of cane to mills located at individual farms; in 1861 there were 43 mills in Natal, in 1868 fifty-seven, and by 1876, sixty-seven. With the growth of coastal railways, it soon became evident that a lesser number of large efficient central mills would prove more economical, and by 1890 the mill numbers had declined to 34 and by 1958 to 18. By the 1870's the time had evidently come to separate the process of manufacture from that of cultivation of the cane, and in those years emerged the two major classes of present growers —the planters, and the miller-cum-planters. The latter were the owners of

[6] A. A. Lloyd: "Sugar in the National Economy," *South African Sugar Yearbook*, 1953–1954.

[7] T. J. D. Fair: *The Distribution of Population in Natal*, unpublished Ph.D. Thesis, University of Natal, 1953.

[8] Annual Summary of Agricultural Data. Experimental Station of South Africa Sugar Association, *South African Sugar Yearbook*, 1954–1955.

[9] Survey of cane production 1952–1953. Sugar Industry Central Board, Durban, 1954.

TABLE II

GROWERS OF CANE

Type of grower	*Number of growers*	*Per cent of cane land farmed*	*Per cent of crop grown*	*Cane yields in tons per acre of cane land*
European planters	800	61.5	63.2	26.41
European miller-cum-planters	19	27.7	28.8	26.65
Indian planters	3000	9.2	6.7	18.65
Bantu planters		1.8	1.2	17.48

large mills which drew from their own estates and from those of neighboring planters. Many of the present mills were established at their present locations in those early days; apart from the Pongola mill they range in age from 26 to 101 and average 53 years. From 1891 to 1957 production of sugar from all the mills increased from 11,235 to 848,645 short tons, not only with increases in cane acreages, but with improvements in milling efficiency; during the last 20 years the over-all recovery has increased from 79.64 per cent to 83.44 per cent.[10]

FIG. 4. Employment in sugar processing establishments, Union of South Africa. (Based on field work.)

The mills and their associated factories are relatively large establishments. During the crushing season they employ large numbers of people, as many as 1195 at the Natal Estates Mill and 1197 at the Rossburgh Refinery (Fig. 4). Europeans and Asiatics (Indians) are generally retained throughout the year, but many Natives return to their homes in the off-season which is used for a full overhaul of equipment. The milling season is the cane harvesting season, and varies in length from mill to mill in accordance with local conditions; in the 1956–1957 season it extended from April 4 to February 25, but most mills normally operate from May to December. What is perhaps most notable from a study of Figure 4 is the relatively low proportion of Indians employed—23 per cent for the group as a whole—when one considers that in the early days they formed the backbone of the industry. Such a picture is indicative of the movement of Indians away from the sugar industry, and of their replacement over the years by Natives. The exceptionally low proportion of Indians in the mill at Riverview, where under 1 per cent are employed, is probably the

[10] *South African Sugar Yearbook*, 1956–1957.

result of their restricted freedom of movement in Zululand. Only at the Glendale establishment which is Indian owned do their proportions rise to as much as 68 per cent. Indians nevertheless figure far more prominently in the sugar-processing industry than they do in sugar growing, where their skilled labor is less in demand.

About half of the sugar cane grown is brought to the mills by road or by light cane railway, while the other half is transported by the South African Railways. Road transport, however, is increasing as a result of recent changes in railway rating,[11] and because of railway difficulties which in the 1954–1955 season, for example, led to a 20 per cent cut in the number of trucks available. Between them the 18 mills draw upon the whole of the sugar belt, and estates normally send their cane to the nearest mill, irrespective of its ownership.

Figure 5 indicates the 1956–1957 output figures of the types of sugar produced at each establishment; the proportions of each type are arranged by the industry as a whole. Most of the larger producers are situated in the main growing areas north of Durban, except for the central refinery at Rossburgh, which draws low-grade sugar from most of the mills. The mills themselves concentrate upon these lower-grade sugars, and produce only limited amounts of whites, but the three mills at Illovo, Sezela, and Natal Estates also produce considerable quantities of refined sugar.

The siting of the mills, in general determined by the areas of cane growing, is in detail dependent upon water supplies. Sixteen out of the 18 mills lie on the banks of rivers, and the others have only to pump their water from short distances. Their precise locations, however, were very carefully chosen, especially in the north, for flood dangers have caused devastation of mills and fields throughout the history of the industry. Some of the older mills which began as small producers are poorly sited in relation to their present water needs, for they were originally erected near small streams. It is significant that the largest river in Natal, the Tugela, has no sugar mill set upon its banks, although it flows through an important cane-growing area. Were new mills to be erected, they would presumably be built near the larger rivers. The Um-

FIG. 5. Sugar production, Union of South Africa, 1956–1957. (Sources: S. A. Sugar Yearbook and field work.)

[11] The transport costs faced by the industry as a result of recent changes in railway rating have increased by almost £500,000 per annum. *South African Sugar Journal*, September, 1954.

zimkulu mill has relied upon its river not only for water, but for transport; until the river was silted-up in 1944, supplies were brought in and sugar sent out by barge. Transportation facilities are necessarily of great importance. Of the 21 establishments shown in Figure 3, only five are set away from railways. The fact that these five are of relatively recent development is indicative of the fact that railway location is not a vital attribute in these days of increasing road transportation. The erection of the mill at Pongola, about 20 miles from the nearest railhead, is perhaps the best example of this, although the fact that it will ultimately be served by a railway suggests the advantages which still accrue from such a transportation medium.

The future spread of the mills is likely to take place in relation to the spread of cane growing, and, since 26 years have elapsed since the erection of the last mill (except for the one at Pongola), few developments may be expected within the present belt South of Mtubatuba; in fact two mills have recently closed down—the Esperanza mill which was moved to the Pongola in 1954, and Shire's mill which discontinued operations in 1956. The two areas most likely to be served by new mills, apart from the northeastern region which has already been discussed, would seem to be the area between Mtubatuba and Pongola, based upon irrigation, and the Pietermaritzburg area, based upon high-altitude cultivation. The reason for the lack of mills in both these areas up to now is very largely the fact that, before mills are built, they must be guaranteed a continuous and assured supply of cane; most coastal farmers, in fact, are committed to producing sugar from a certain proportion of their lands for periods varying from 20 to 100 years in the future. Such stability has yet to be achieved in the more recent cane growing areas, except for the Pongola region, where assured production has been obtained through governmental efforts.

Apart from some fuel and chemical requirements which are obtained from distant sources, the mills are remarkably self-sufficient in relation to the resources of their local areas. Coal is railed from the Vryheid, Dundee, and Newcastle mining areas of northern Natal for the nine mills and the three associated establishments which use it, and in addition fuel oil is obtained from Durban for one mill at Felixton. Phosphoric acid and sulphur is obtained from a large chemical factory at Umbogintwini near Durban. The latter commodity is not used at present by the Maidstone and Illovo mills, which are representative of the industry as a whole in that they are continually experimenting with changes in processing methods. Lime for use in all the mills is obtained from the Northern Cape or from the Port Shepstone area of Southern Natal.

All the mills are steam driven, 14 of them generating their own electricity and the remainder dependent upon the Electricity Supply Commission. The main fuel used in every mill for steam raising, sometimes supplemented by coal, is bagasse or waste cane. In earlier days the bagasse was slowly dried in the sun, but for many years it has been run direct from the rollers to the boilers. Firewood is also used in almost every mill for starting the boilers, and is obtained from local sawmills. These are located in the coastal Eucalyptus saligna forests of the north, and in the interior wattle forests of the south.

In terms of disposal of its produce, however, the industry is by no means confined to the coastal area. Apart from a very small percentage of sugar sold locally at the mills, and some 7000 tons

used annually at Illovo for the production of Golden Syrup, the sugar is normally packed in bags drawn from a Durban depot, and sent by rail (or by Road Motor Transport where necessary) to Durban. The Pongola mill sends its sugar by Road Motor Transport to Piet Retief, for distribution throughout the eastern Transvaal. The sugar mills have an agreement whereby their rail costs are evened out so as to compensate for varying distances from Durban. About 30 per cent of the sugar is dispatched from Durban either at once or after storage, for direct consumption within the Union. Surplus sugar, which amounts to about 20 per cent of production, is exported—in bulk rather than in bags since 1953—under an export quota agreement which since 1951 has allowed exports of 200,000 tons; 183,381 tons were actually consigned in 1956–1957 mainly to Britain, but also to Southern Rhodesia, Canada, Kenya, and Nyasaland. The remaining 50 per cent of production is refined, the essential process being the removal of impurities and a film of molasses to satisfy more discerning markets and to ensure better storage. About 75 per cent of the refined sugar is produced at the central refinery at Rossburgh, near Durban, and the remainder at the Natal Estates, Sezela, and Illovo mills.

Table III indicates the markets of the white sugar sold in the Union during 1956–1957.[12] The importance of sugar to the food-processing industry is obvious. Equally important is the fact that the direct per capita consumption within the Union of South Africa and the Protectorates of Swaziland, Bechuanaland, and Basutoland has risen from 40 pounds per annum in 1936, to 70 pounds in 1956,[13] largely as a result of increasing Native consumption; sugar exports may well be affected if this trend continues.

TABLE III

MARKETS OF WHITE SUGAR, 1956–1957

	Short tons
Civilian trade	374,714
Government institutions	3,116
State food depots	3,937
Canners	40,598
Condenseries	12,855
Manufacturers	71,123

Sugar milling yields a number of by-products. One of them is filter cake or filter mud, a residue left after crushing. This is used as a fertilizer, and is disposed of to local growers, in proportion to the amount of cane they send to the mills. In the case of the mill at Riverview, the filter cake is distributed to planters much farther south, for up to the present there has been little need of fertilizers in the rich Umfolosi Flats area tributary to the mill. Another by-product, molasses, is far more important. It is normally sent to a factory at Merebank near Durban, where it is converted into a variety of products including Methylated spirits, alcohol, ether, and motor spirits; these are distributed throughout the Union. The mill at Melville, however, uses its molasses, mixed with sifted and dried bagasse pith, to produce some 3000 tons of stock feed a year, and distributes this throughout the Union and Southern Rhodesia. Two other mills, both of them located away from railways and thus incurring high costs in marketing their molasses, are also considering similar operations. Rum is not at present made in Natal, although in the past it seems to have been another important industry associated with sugar milling. In 1861 a rum distillery existed at the mouth of the Umgeni near Durban, and by 1881 there were 19 in Natal;

[12] *S. A. Sugar Yearbook*, 1956–1957.
[13] *Idem.*

in 1904 the number had decreased to three, and by 1919 to two.

Further developments in the range of chemical by-products seem inevitable, in view of the very efficient research organizations maintained by the sugar industry. One may note, for instance, the recent establishment of a plant for extracting cane wax from filter cake at the Darnall mill. Of much larger scale is the Ngoye paper mill built in 1953 next to the Felixton sugar mill, and controlled by members of the sugar industry. Its raw material is bagasse, to be obtained from the three mills of its group at Felixton, Darnall, and Amatikulu, although at present all its requirements are received from the large mill at Darnall. The bagasse is supplemented by waste kraft paper railed from a Durban packaging firm, but future plans envisage replacement of this paper by wood pulp. The factory turns out rolls of brown paper used for packaging, and supplies manufacturers of cardboard containers all over the Union and the Rhodesias; hard and soft boards seem to be possible future products. Like other Natal board, paper, and pulp mills which are based upon timber supplies, the mill functions because of the relatively large market of southern Africa, and because of the availability of a surplus material like bagasse or wood. The establishment of the factory is indicative of the extent to which the sugar industry is extending its interests. It is significant that at present the factory can use only the bagasse fiber, and that the remaining pith can be used to produce stock feed, as described above; in the future, however, it may be possible to use the whole of the bagasse for paper making.[14] At all events the use of bagasse as a raw rather than as a waste material poses certain problems for the sugar industry. In the first place there arises the need for conserving the material, and one idea being considered at present is to introduce a method of drying the bagasse artificially, so that it may be used as a fuel in less quantity but with increased efficiency. Carrying this a step further, it may well be that mills will completely discard bagasse as a fuel, and will divert it to the existing paper mill and to possible future mills. It is significant, therefore, that one sugar mill began using coal as a fuel for the first time in 1954, and that another is considering doing so; both expect to send their bagasse to paper mills. Such a change in fuel will inevitably renew interest in the little-known coal resources of Zululand. Immense hopes were aroused by earlier discoveries of small outcrops at Compensation and at Somkele near Mtubatuba, and at present the development of such small workings as at Ntambanana near Empangeni are of local significance. A large-scale local source of coal, even of low grade, would be of as much importance now as in the past, not only to the sugar industry, which uses some 120,000 tons of coal a year, but to the whole range of industries present along the coast and especially in the Durban area.

[14] Dekker K. Douwes: "Some notes on the utilisation of bagasse," S. A. Sugar Technologists Association Congress, Durban, 1954.

BOOK REVIEWS

Historisch-geographisches Kartenwerk Indien: Entwicklung seiner Wirtschaft und Kultur. Prepared under the direction of EDGAR LEHMANN by HILDEGARD WEISSE. 90 maps on 16 sheets. With text, 18 pp.; index. (Historisch-geographisches Kartenwerk.) Verlag Enzyklopaedie, Leipzig, 1958. DM 55. 17 x 11 inches.

Two standard criticisms of economic atlases—and textbooks, too, for that matter—are that they do not provide information about the social context of economic activities, being concerned with products to the virtual exclusion of the people who are producers and consumers, and that their purpose is usually confined to the presentation of a static picture of the transitory present. The work under review is an experimental attempt to improve upon existing economic atlases in these two respects, following the example of certain European historical atlases. India, that is, the geographic region of that name, the subcontinent, for which a wealth of data little exploited in this way exists, was chosen to be the first area to be described by a set of "historical-geographic maps having a fundamental economic orientation."

The atlas consists of 16 unbound sheets, of unnecessarily awkward size, containing 90 maps prepared under the supervision of Hildegard Weisse, the general direction of the project being in the hands of Edgar Lehmann, who provides an introduction. The maps give a spatial frame of reference to the following broad categories of phenomena: highlights of Indian political history, production of goods during the modern period, characteristics of modern Indian society (education, health, religion, etc.), people in place (population density, settlements) and people in movement (transportation, trade routes, migrations). There are several interesting asides and novel departures from the more conventional map treatment of these themes. Such are the maps entitled *The significance of cotton for India*, a remarkable attempt at an historical résumé; *India's irrigation works and their historical development*; *Pilgrimages*, a long overdue cartographic treatment of a vital Indian institution; *India's socio-economic reforms in the spirit of Gandhi*; and *Growth of the Tata organization*.

Getting the very latest statistics for some of the maps was evidently not a matter of prime concern, and this was probably wise, for an emphasis on the immediately contemporary is not essential to the chief purpose of the atlas. For example, statistics on literacy in the 1951 Census of India have not been used, although several maps contain references to events in 1955 and 1956. However, the fact that there is no reference to such political changes as the ceding of Pondicherry to India in 1954 or the reorganization of states in 1956 provides a better guide to the date of completion of the bulk of the work than does the publication date. The primary source of data is, of course, the Indian census, of 1951 as well as of former years, supplemented by other British sources such as Bartholomew's *Atlas*, Murray's *Handbook*, and Spate's recent text. No ideological bias is apparent in the selection of facts or their mode of presentation, and the maps maintain the high standards of accuracy characteristic of the best German scholarship. Misspelling, a common defect of such detailed special maps, is rare. High standards of map reproduction technique are also maintained, as one might expect from work done by Haack; one cannot find fault with the clarity of line and color, the placing of point symbols and lettering exactly where intended, or the precise positioning of color patterns in appropriate spaces.

It is the more regrettable, therefore, that these technical skills should have been in many cases unwisely exploited. Many of the maps are so choked with matter as to be scarcely comprehensible and are in a few places actually undecipherable. Maps at a scale of 1:30,000,000 are covered with place names, point symbols which often include a large number of letter symbols and arbitrary geometric shapes, arrows with abbreviated labels, and patches of cross-hatching, all of these occurring in four or five different colors on the same map. Some of the colors like black and red stand out prominently, while others like pale green or brown are perceived with difficulty, but relative visibility of the color used for a particular category often seems to be unrelated to the importance due that category in the map scheme. Disconnected segments of legend, graphs and explanatory footnotes in fine print are frequently crammed into empty spaces around the maps. One of the less cluttered of the small-scale maps, showing the distribution of "minerals, other than fuels, iron and ferro-alloys," has a cross-classification of 24 minerals, each represented by a different geometric shape, and 12 historical periods of exploitation, each represented by a particular color combination; periods are designated in general terms such as "prehistoric to modern times," "antiquity," "antiquity to middle ages," "middle ages to the present." The authors of the atlas seem to have forgotten that a map which may be a *tour de force* as a compila-

tion of knowledge or demonstration of technical skill can yet be a cartographic horror.

Surprisingly, there are instances of maps which seem, by contrast with those described, terribly inefficient in their use of space and ineffective in their presentation of information. Four separate maps at a scale of 1:35,000,000 are used to show political India in 1905, 1911, 1921, and 1931, during which period the only significant alterations were the partition and subsequent reconstitution of Bengal in 1905 and 1912 respectively. The territorial changes affecting Bengal could surely have been shown much more clearly on a single map, possibly together with relevant linguistic and religious distributions; these would have helped to explain the political conflicts which the changes brought on. In another case, the use of three maps utilizing pie-charts for major administrative divisions to show linguistic distributions in 1901, 1931, and 1951 seems ill-considered. Although a comparison of the three maps shows several striking differences in pie-chart patterns, these are almost entirely due to revisions of linguistic nomenclature and classificatory techniques, or to reorganization of the census territorial divisions. The three maps are not really comparable and are altogether far less useful than a single detailed map based on district data would have been.

One aim of the atlas, in Lehmann's words, was to strive for a graphic synopsis of carefully sifted data from historical and cartographic sources. While there is no question that the sifting has been thorough, the authors have not always managed to present their information intelligibly by means of the map medium. But students of India will certainly want to have this atlas on their reference shelves, for the authors have succeeded admirably in another regard, that is, in their aim to provide in a compact collection the cartographically expressed facts of India's economic history, a work which they feel is a prerequisite to any meaningful historical synthesis in the future.

DAVID SOPHER

Sacramento State College

Industrial Evolution of Columbus, Ohio, by HENRY L. HUNKER. xxv and 260 pp.; maps, ills., bibliogr. Bureau of Business Research Monograph Number 93, Bureau of Business Research, College of Commerce and Administration, The Ohio State University, Columbus, Ohio, 1958. $4.00. 260 pp. 6 x 9 inches.

The title, *Industrial Evolution of Columbus, Ohio*, accurately describes the contents and approach of Henry Hunker's recent book. Although only the first three chapters, which trace the gradual growth of industry in the city, are organized historically, the larger section of the volume, an analysis of present-day manufacturing, gives heavy emphasis to the founding of individual plants and probes their subsequent development. Chapters on the distribution of plants within the city and comments on the future of manufacturing in Columbus also exhibit a historical bent.

Columbus, we learn, was founded as a political center in 1812 and for about 50 years manufacturing was limited to goods with a local market. After 1870, profiting from connections with an inter regional transportation system, some new industries were developed, based on near-by raw materials. Hardwood lumber supplied an important carriage and wagon industry; near-by natural gas discoveries gave rise to several plants manufacturing glass. However, the community was generally apathetic toward new industry, and long term prospects were based upon the somewhat dubious attractions of low wage rates and on absence of union activity.

A large Curtis-Wright aircraft plant, built by the federal government during World War II, shook Columbus out of its traditional industrial doldrums. Workers were trained (it was surplus labor that attracted the plant), supplier factories were built, and, by the end of the war, some 25,000 semi-skilled workers were employed by the aircraft industry in the city.

Both the aircraft plant and the pool of labor that was trained in it have been post-war assets. North American Aviation occupies the buildings and employs about 17,000 workers (1953) making it by far the largest industrial employer in the city. Both General Motors and the Westinghouse Corporation have built plants in the city in the post-war period, attracted by the newly trained labor.

The largest section of the book is based on an analysis of data obtained from interviews with representatives of 204 manufacturing concerns in the city. All plants with ten or more employees (except certain ubiquitous types) were included in the survey. Among other questions, the official was asked to "evaluate the various forces which influenced the location of the plant in this city." The industries are then classified into types, groups, and subgroups, and analyzed in terms of location factors. Most of the discussion is on the subgroup level and many plants are described individually in full detail. Procedures are essentially traditional: no complex statistical manipulations are attempted.

Books in the field of industrial geography are not yet abundant, and, although studies focused on individual cities are perhaps the most numerous, an additional volume is always welcome. Previous studies have generally considered cities dominated by industry, while in Columbus industry is of less than average importance. Perhaps the greatest contribution of this book is the wealth of detail it reveals on the circumstances surrounding the location of individual

industries in Columbus. Students of both industrial and urban geography should find it valuable for comparative studies, and it should find an interested audience among the citizens of Columbus.

Further, although seeming to be essentially a dissertation, this work is *published* and hence is readable, "referable," and reviewable. Two hundred sixty pages in length, it comes to us printed and bound in hard covers, through the sponsorship of the Bureau of Business Research at The Ohio State University. This is heartening in an era when, with increasingly rare exceptions, the major works of our younger scholars are available only on eye-straining, stomach-upsetting microfilm. The appearance of an occasional printed dissertation should spur both authors and departments on a diligent and imaginative search for legitimate publication outlets for their better research efforts.

HOWARD J. NELSON

University of California at Los Angeles

Rich Lands and Poor—The Road to World Prosperity, by GUNNAR MYRDAL. xx and 168 pp., Vol. 16 of *World Perspectives*, edited by RUTH NANDA ANSHEN. Harper & Brothers, New York, 1957. $3.00. $5\frac{1}{2}$ x $7\frac{3}{4}$ inches.

Gunnar Myrdal, the Swedish economist who directed the definitive study of the American race problem, has now added very significantly to our understanding of world iniquities. The small size of the volume belies its significance to all who are interested in world trade, regional economic development, and the relations of one nation to another.

Invited to give the Anniversary Commemoration Lectures by the National Bank of Egypt, Dr. Myrdal chose to question the traditional economic approach to international trade and national development. He preserves in this revision the informality and non-technical nature of the lectures. His thesis, however, is profound and his conclusions are revolutionary.

Starting with the existence of enormous inequalities in level of living and economic productivity and the tendency for these inequalities to increase, he asserts that the traditional assumption in economics of a stable equilibrium does not and cannot explain these differences. Rather one must use the principle of circular causation: that one economic advantage begets another and these two a third and so on. "If things were left to market forces unhampered by any policy interferences, industrial production, commerce, banking, insurance, shipping, and, indeed, almost all those economic activities which in a developing economy tend to give a bigger than average return . . . would cluster in certain localities leaving the rest of the country more or less in a backwater." Thus, the rich region gets richer and the poor region gets poorer. Inter-regional movement of people, capital, and goods, increases the inequalities.

He modifies this original assertion so as to include the "spread" effects—the tendency of the industrially advanced area to spread gradually. However, not until government policies are instituted, counteracting the "natural" economic centralization and reinforcing the spread effects, does a country achieve any large measure of regional equality. This has happened only in the "developed" countries. (He specifically excludes the Soviet Block from his generalizations.)

No such equalizing force exists to overcome the localization of economic growth within the international economy. "Spread" effects are weakened by national boundaries. Economic advantages which do spread to "underdeveloped" nations tend to focus in tiny enclaves at port cities or capitals.

With this basic thesis and its modifications stated and illustrated in less than 70 pages, Dr. Myrdal develops the implications to the underdeveloped nations, pointing out that circular causation can be turned to their advantage. Now that they have been freed of colonial status, formal or informal, the disadvantaged nations must carefully weigh the means for economic growth available to them. With careful planning within nations and with joint action among them, the weaker, poorer countries can achieve a measure of equality with the "great" powers.

Fiscal controls, ownership or management of the exploitation and export of raw materials, protection for new industries, austerity in consumption while investing in capital goods are all justified as necessary to the economic development of the lagging economies. Under certain conditions even export subsidies are justified.

Dr. Myrdal does not minimize the hazards along the way. "Rational nationalism" as he describes it is a fine line between traditional stagnation and overcharged emotional nationalism. To find and hold that line is his challenge to the young social scientists of the underdeveloped nations.

It is not explicit in the text but the conclusion must be drawn that the economically advanced countries of the West must use restraint upon their own short-run self interest to permit the industrialization and modernization of the other four-fifths of the world. Failure to use such restraint can only result in a continued widening of economic inequalities and consequent intensified political tensions.

It follows that free trade is the selfish policy for economically advanced countries, that underdeveloped nations have special protection needs, that they must provide their own protection until a world government develops which can put into effect the kind of equalizing regulations

which are now in force within the economically advanced democracies.

This is a forward looking book, full of significance to all who are concerned about world problems today. It is equally significant to all who would understand the economic effects of colonialism in the past or who need the theoretical framework to explain the growth of the ecumene within a nation or the predominance of so few industrial regions in the world.

NICHOLAS HELBURN

Montana State College

Die Seehafen des österreichischen Aussenhandels, by J. KULIGOWSKI. 52 pp.; maps, bibliogr. Wiener Geographische Schriften No. 1, Verlag Ferdinand Berger, Horn, Niederösterreich, 1957. DM 4. 9½ x 7¼ inches.

The Port Traffic of the Oslofjord Region, by T. OUREN. 168 pp.; charts. Publications of the Norwegian School of Economics and Business Administration, Geographical Series, No. 6, J. W. Eides Forlag, Bergen, 1958. kr. 25. 10½ x 7½ inches.

These two books present studies concerned with the geography of transport and prepared at the geographical departments of schools of economics. Nevertheless, they are quite different in their aims, approaches, and methods. The first, published as the first paper of a new geographical series edited by the Viennese School of Economics, deals with the problem of ports—outlets for the foreign overseas trade of an independent inland region: Austria. The Norwegian study analyzes statistically the ship traffic and cargoes in the ports of the Oslofjord region, e.g., of a group of ports, forming together an autonomous functional whole—an economic seaboard region.

J. Kuligowski in his work describes systematically the role of seaports in Austrian foreign trade; the geographical positions of the three main ports—Trieste, Hamburg, and Bremen—in relation to the high seas and main sea lanes; the historical development of each port and the cities corresponding to them; communication lines between those ports and Austria; principles of the specific economic and freight policies of land transport and port development; and, lastly, the importance of the ports for the Austrian economy.

The Austrian geographer shows that as a result of the freight policies the differences in distances between different ports and Austria do not play great roles in the selection of ports. The division of labor between different ports is based on their geographical position in relation to the overseas foreign markets. Trieste (and in the last years Rjeka) is used for shipments to and from the Middle East and Southern Asia; Hamburg and Bremen for traffic with Northern and Western Europe and with both Americas. Division of tasks between Hamburg and Bremen is made on basis of their technical equipment for the loading of different commodities.

The general volume of traffic is steadily growing. In fact the maximum in the case of Trieste in the last years before the World War I was reached in 1954. On the whole Kuligowski is yet extremely restrained in his conclusions. He is factual, avoiding comparisons or evaluation of collected data and obtained results.

T. Ouren after giving definitions of the main statistical divisions and analyzing the value of existing data discusses his subject in the following chapters: number of dry cargo vessels, nature and volume of dry cargoes, number of tankers and volume of liquid cargoes, loading co-efficients for single ports and for the whole region, character and volume of transit, trade statistics, directions and intensity of sea traffic, and coast traffic. Finally, he compares collected statistical data for 1951 with those data that were obtainable for 1939.

The results of Ouren's research are even more difficult to sum up than those of Kuligowski's. His work is clearly statistical and descriptive. Drawing of conclusions is left largely to the readers. There is a definite lack of comparative data which would allow an appreciation of described facts and their meaning. On the other hand, from the methodical point of view the Norwegian study is of some importance. The author gives a systematic review of basic concepts characteristic and significant for the geography of sea transport. For instance he discusses and defines basic differences between liners and tramps, showing the overlapping of these two main classes of ship transport and differences between dry and liquid cargoes, splitting them first into general and mass cargoes and indicating possibilities of overlapping. The whole sea traffic he divides into coastal, European, and overseas. A whole chapter is set aside for discussion of loading co-efficients, a concept used before by other authors.

Another pair of concepts important for the geography of ports is that of hinterland and foreland. The first is well known among geographers. Ullman in 1943 defined the "primary hinterland" as an area in which the position of the port was firmly established. Morgan in 1951 introduced a similar term of the "basic hinterland," enclosing all "those railway traffic districts and inland waterway districts which in 1937 both received from each port a minimum total of 50,000 tons of goods and shipped the same quantity to it, by rail or waterway or a combination of the two."

On the other hand the concept of foreland (e.g., all regions connected with the given port by ocean ships) was used for the first time by Weigend. In his study Ouren uses both terms in a very convincing, logical, and useful manner.

The Norwegian geographer speaks of transit traffic and transit trade. He introduces the additional term of re-export for elements which are both transported and sold in transit. He uses also the division of transit into active and passive. The first denotes the intermediary countries; the second, countries sending or receiving given commodities. The analysis of passive transit is of some importance both for the understanding of characteristics of shipments and trade and for research into the possibilities of the elimination of intermediaries but is extremely difficult to use because of the lack of proper statistical data. As a result, in spite of its descriptive, statistical character the work of Ouren makes a very good impression on the reader as it is systematic, precise, and extremely well documentated.

Speaking generally both studies raise again the fundamental question whether geographical research may and should be limited to pure description. This question is even more important in such a case as that of Ouren where we deal with a work that represents a very high standard of execution based on carefully collected and analyzed detailed data. It seems that an interpretation of the discovered reality is necessary. For the measure of such an interpretation, on the one hand comparison in time (dynamics of development) and, on the other, comparison in space, in relation to other geographical areas or countries, may be used. Some may say that these imply only a wider and deeper description. After all Kuligowski gives us some information about historical development and Ouren at the end of his book makes an effort to compare materials collected for 1951 with the limited data for 1939. But really important and significant is the necessity for the introduction of evaluating conclusions. Their aim should be to classify the facts according to the established typology, to find out what is typical or not from the point of view of social development in the given geographical environment. Such evaluation of the obtained results may be done also from the point of view of the social needs. In this case the question asked shall be whether the present position is the most advantageous for the human, social development. What in this position is propitious? And what forms an obstacle in the fulfilment of the social aims? But in this last approach we are coming to the problem of the applied geography, to the problem of science involved in the practice of everyday life, especially of economic life.

KAZIMIERZ DZIEWOŃSKI

Institute of Geography, Warszawa, Poland

The Soviet Aluminum Industry by THEODORE SHABAD. 25 pp.; ills., maps, bibliogr. The American Metal Market, New York, 1958. $25.00. 11 x 8½ inches.

The attention that has been focused upon the iron and steel industries of the Soviet bloc has tended to hide the fact that progress no less remarkable has been made in the field of the non-ferrous metals. In all fields, statistical data is hard to come by, and is usually inadequate and often expressed in percentages. This latter is not, however, an exclusively Soviet technique; it was used in some of its official data of the Hapsburg Empire in the nineteenth century. Nevertheless, in the field of ferrous metallurgy an adequate picture of the distribution, technology, and efficiency of the industry can be formulated, as has been demonstrated in the pages of this journal (see "Migration and Economic Growth, A Study of Great Britain and the Atlantic Economy," by Brinley Thomas, reviewed by Thomas R. Smith, *Econ. Geogr.*, Vol. 32, 1956, pp. 87–88). This does not apply to the light and alloy metals. As Mr. Shabad points out in his foreword, quoting a Soviet decree, "all data on the production capacity and production plans of non-ferrous, precious and rare metals enterprises as well as the fulfillment of these plans in terms of actual numbers" are classified as state secrets. The technological literature is a mine of information on ferrous metallurgy, but not on non-ferrous.

In these circumstances this pamphlet assumes an enhanced importance. It is even likely to be of value to the Russians themselves, for the claim is made for it that "no single published Soviet source contains the mass of information assembled by Mr. Shabad on the Soviet aluminum industry." This pamphlet is the "exhaustive study," of which a condensed version, without footnotes and references, was published in the *American Metal Market* of September 12, 1958. This, like the earlier edition, has been pieced together by assembling and co-ordinating the many fragmentary references to the aluminum industry in the press and governmental utterances of the Soviet Union. It has been a laborious task, and the result is impressive testimony to what can be learned from outside about a secret industry.

Between the years 1945 and 1955, the output of aluminum increased sixfold, and in the latter year the Soviet Union stood in third place, after the United States and Canada, among world producers of aluminum. There can be no doubt that now Soviet production exceeds that of Canada and may within two or three years approach to within two-thirds of the American figure.

Mr. Shabad traces this growth in detail. He presents a picture of the Soviet aluminum industry during the pre-war period, when the production of both alumina and metallic aluminum was limited to the Volkhov area, Zaporozhye, and Kamensk in the Urals. He traces the wartime abandonment of the western centers and the expansion of production in the Ural Mountains and the postwar spread of the in-

dustry to Karelia and Kandalaksha, to the Kuzbas, and to the Trans-Caucasian Republics, and, very recently, to Irkutsk and Kazakhstan.

This spread has been made possible by the use of other sources of alumina than bauxite. Nephelite, alunite, kyanite, and sillimanite—all of them silicates or phosphates of aluminum—occur in considerable or large amounts. Some deposits have been found only recently and encourage the belief that more may yet be discovered. The extraction of alumina has presented technological difficulties which seem now to have been overcome. The reduction processes yield by-products, including phosphates and cement, but the cost of production must inevitably be high. The Soviet Union has, in effect, ceased to be a significant importer of Hungarian bauxite, and has become a considerable exporter of crude aluminum. As the author, quoting Mikoyan, remarks, "The Soviet Union is selling aluminum to the very countries that are forbidden to sell to the Soviet Union."

The pamphlet ends with a gazetteer of mining and processing centers in the Soviet Union and a rough evaluation of their relative importance. The stages in the growth of the industry are illustrated by a series of maps. The paper makes no attempt to study the economics of the industry. It is implicit, however, that the selection of sites for the industry is oriented toward sources of electric power, either hydro or thermal. This necessitates long-distance movement of either bauxite or alumina. The logistics of the industry appear no less important than those of the iron and steel industry, but the evaluation of the transportation factor in total costs is clearly impossible. This admirable pamphlet is highly condensed and rather technical. It would be uncharitable to suggest that it might have been expanded, but one greatly needs more work of this kind.

NORMAN J. G. POUNDS
Indiana University

The Staple Food Economies of Western Tropical Africa, by BRUCE F. JOHNSTON. x and 305 pp.; maps, diagrs., tables, appendices, index. A Publication of the Food Research Institute, Stanford University Press, 1958. \$6.00. $9\frac{3}{8}$ x $6\frac{3}{8}$ inches.

This study of the staple food crops of western tropical Africa—defined here to include not only West Africa but also French Equatorial Africa, Angola, and the Belgian Congo—fulfills an urgent need: a critical evaluation of published materials relating to these crops in the region. An attempt has been made to bring together all information about the distribution and characteristics of the major food crops—notably millets and sorghums, maize, rice, manioc, yams, plantains, cocoyams, and sweet potatoes.

Yet this is more than simply a source book. The author considers his subject and region in such a way as to bring out similarities and contrasts between different staple crops and between different areas. Moreover, he pays particular attention to physical as well as to social, economic, and historical factors influencing the distribution of crops. The whole study is related to the now familiar problem of whether food production in the region will increase fast enough to satisfy the rising demand of the nonfarm population.

The first five chapters include a summary of the physical environments for staple food crops in the region. Stress is rightly laid on the moisture factor which, "always important for agriculture, is all-important in the area considered in this study" (p. 29). There follows a careful analysis of the geographical distribution of staple crops; this chapter contains several interesting and well-drawn maps based on area relatives computed from annual statistics. The two maps 4-1 and 4-3 illustrating the geographical distribution of dominant, co-dominant, and secondary crops are of especial value and will be widely used by geographers. Another chapter summarizes the chief physical characteristics of the major staple food crops with which this book is concerned.

The second five chapters make up almost two-thirds of the book and include a long discussion of the economic factors in distribution—relative yields, relative production costs, consumer preferences, relative prices, and nutritional considerations. The author clearly points out the importance of factors often ignored by many writers: for instance the high proportion of the labor time of food production which is devoted to post-cultural operations such as shelling, cleaning, and grinding corn; and processing manioc roots into *gari* (manioc flour). The lack of tested basic information is particularly striking in this section of the book, and underlines the limitations of confining agricultural research to physical factors. To this reviewer, at least, this whole study gives support to the view that economic geographers cannot reasonably or legitimately continue to ignore the "purely economic" or "non-geographical" factors in their analyses.

The examination of social, cultural, and historical influences on the pattern of crop distribution in the region is necessarily rather tentative and even superficial. Geographers will be particularly interested in the attempt to discover relationships between population distribution and the pattern of production of the staple food crops. The author is well aware of the dangers of trying to establish causal relations in this field and agrees that in general there does not appear to be any real evidence for making any. Nevertheless, he points out the interesting phenomenon of the high density of population along the coast between Lagos and

Accra, which may in large part be explained in terms of the role of manioc and maize as the dominant staple crops throughout the drier portions of that area. A further chapter discusses the place of staple food crops in African diets, the pattern of food consumption, and the preharvest shortage or "hungry season"; this provides an objective summary of the various conflicting views.

The final chapters deal tentatively with changes that are likely to occur in the position of the staple food crops and with prospects for increasing productivity and enlarging staple food supplies. In this way the reader is brought back to the central theme of the relation of staple food crops to economic development generally. There seems to be some evidence that rice and bread are becoming increasingly important foods in the region. And the author concludes that there is nothing intrinsic in the situation which warrants pessimism in any appraisal of the prospects. In spite of climatic and soil difficulties, there are strong indications that "the expansion of agricultural output in most if not all western tropical Africa will keep pace with the growth of demand . . . and so . . . make a positive contribution to the process of economic development" (pp. 282–283). This conclusion is possibly over-optimistic, tending perhaps to underestimate the potential for population growth and to overestimate the ability of the African to change his cultural and dietetic habits.

For the research worker in the field, this volume will again and again suggest a line of inquiry and provide a background of balanced commentaries on previous published materials. Dr. Johnston's book is a noteworthy piece of geographical writing, and essential reading for all those interested in Africa and in the economic development of tropical areas everywhere.

B. W. HODDER

University College, Ibadan

Hua-pei Ching-chi Ti-li, edited by SUN CHING-CHIH. Peking, China, 1957. Translated as *Excerpts from "Economic Geography of North China."* 270 pp.; maps. U. S. Joint Publications Research Service (JPRS/DC-144). 1958. 8 x 10½ inches.

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Nei-meng-ku Tzu-chih-ch'u Ching-chi Ti-li, edited by SUN CHING-CHIH. Peking, China, 1957. Translated as *Excerpts from "Economic Geography of the Inner Mongolia Autonomous Region."* 125 pp.; maps, tables. U. S. Joint Publications Research Service (JPRS/DC-368). 1958. 8 x 10½ inches.

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Hei-lung Chiang Sheng Hei-lung Chiang Chi Wu-su-li Chiang Ti-ch'u Ching-chi Ti-li, by WU TE-CHUN, KUO LAI-HSI, and HSIEH HSIANG-FANG. Peking, China, 1957. Translated as *Economic Geography of the Amur and Ussuri River Regions of Heilungkiang Province.* 161 pp.; maps, tables. U. S. Joint Publications Research Service (JPRS/DC-411). 1958. 8 x 10½ inches.

These monographs may be purchased from the Photoduplication Service of the Library of Congress, Washington 25, D. C. Price four cents per page.

The publication of these five monographs and their translation into English is significant on several counts: they are the first geographic studies from Communist China to become generally available in this country; they contain a considerable amount of relatively recent and detailed information for several important regions in China; and their issuance provides some indications of the type and quality of work by geographers under the Peking regime. All studies were written by members of the Institute of Geography, Academia Sinica, and issued under its auspices, and all are accompanied by numerous maps based upon the results of recent surveys and research. The monographs vary in organization and approach. Those on North China, Inner Mongolia, and Kwangtung Province are devoted chiefly to regional description. Their organization consists of a systematic description of physical conditions, history and general geographic characteristics, population, and economy, followed by more detailed treatment of the same topics within the framework of various types of areal divisions. The monographs on the "Western Region of the Middle Yellow River" and on the Amur-Ussuri region also contain considerable descriptive material, with appreciable emphasis upon critical problems and their proposed solutions.

Perhaps the most significant monograph is that on North China, since it deals with the provinces of Hopeh, Honan, Shansi, and Shantung—a core region of both ancient and modern-day China. Although the study contains useful material relating to industry, transportation, and population, the most valuable part is a detailed discussion of North China's agricultural geog-

raphy. Of particular interest is the subdivision of each province into five to nine agricultural areas defined, according to the authors, on the basis of "geographic differences, crop combinations, problems, and potentialities" (p. 177). Of these the major criterion appears to be crop combinations. To facilitate statistical comparisons between areas, their limits follow *hsien* boundaries. Despite the fairly comprehensive discussion of agriculture, the text alone would be difficult to interpret and use without the impressive number of detailed maps that accompany it. Most useful of these maps are those which depict for each *hsien* of North China the relative importance of the four major crops (wheat, cotton, millet, and corn) each expressed as a percentage of total crop acreage, irrigated land expressed as a percentage figure of total farmland, and double-cropping ratios. The latter two maps are extremely useful in view of the strenuous efforts of the Chinese to increase the irrigated land and double-cropping areas in North China. Also included is an illuminating isopleth map of the distribution of farmland as percentages of total land area. A comparison of these maps with the corresponding maps compiled two decades earlier and published in John L. Buck's atlas of *Land Utilization in China* reveals similarities in basic land use patterns, with some local differences also apparent.

The major limitation of the North China study is its lack of absolute figures. This gap makes it necessary to refer to other sources for essential totals. If time is no object, it is possible to obtain approximate figures by taking province area totals and then computing the amount of land in farms. The ratio of farmland to total land area is given for each province, with the notable exception of Hopeh. From this figure other approximations can be computed from the maze of percentage figures. The paucity of absolute figures also impairs the value of the sections on industry and transportation. All too frequently, vague statements are made such as "59 times more new walking ploughs were sold in 1953 than in 1950 and the sales volume of two-wheel, twin-blade ploughs in 1953 was 1.7 higher than in 1952" (p. 151).

In contrast to the North China study, the monograph dealing with the Western Region of the Middle Yellow River focuses upon an area that until very recently was largely isolated from Chinese centers of control and of inconsequential significance to China's economy. But the region, which is defined as extending from Lanchow to Paotow, is one of emerging economic significance; and the completion in 1958 of the Lanchow-to-Paotow railroad provides the necessary stimulus to speed development of the region.

About one-half of the text is devoted to an intensive inventory and analysis of "productive conditions," a heading under which regional differences in economic production, agriculture, animal husbandry, manufacturing and mining, and forestry and fishing are discussed. Although the treatment of all of these topics is comprehensive—much of it arranged in convenient tabular form—greatest emphasis is placed on the critical topic of water conservation, which receives intensive and minute attention. Of particular value are tables on the trunk canals along the Yellow River, which, in most cases include the volume of water impounded and localities irrigated and in all cases give the total irrigated area (in *mou*). Various analyses are made of the use of water and its relationship to the agricultural economy of the area. As stated in the text, "problems of irrigation in this region is [sic] inseparable from the characteristics of small farm economy" (p. 85). It will come as no surprise that collectivization is urged (the text was written in 1954) to achieve the goals of proper use of water and increased production.

A surprising amount of information is given on trade and transportation of the Western Region of the Middle Yellow River. The inventory of transportation media is well nigh exhaustive. One learns, for example, that there were 83 automobiles, 6803 rubber-wheeled carts, 10,864 iron- and wooden-wheeled carts, and 7436 pack animals in the "neighborhood" of Paotow as of 1952 (p. 143). A classification of market centers is attempted. Four classes are given, along with the criteria used in their definition; and for three of the classes the number and the names of the urban centers are listed. Total commodity flow statistics as of 1952 are given for the entire region (coal, foodstuffs, and salt rank in that order). These figures, in turn, are broken down by major commodity—although absolute figures are not always provided—and by the major urban centers.

One disappointing feature is the limited information concerning the development of heavy industry. The coal fields are described but output figures are withheld. No mention is made of the iron-ore deposits at Paiyünopo north of Paotow that will feed the new iron and steel complex of that city. Curiously, a very brief mention of these ore deposits is made in the Inner Mongolia study.

The usefulness of the Yellow River study is reduced by the very poor reproduction of the key orientation map. About 400 names are shown on the map, but most of them are "lost" because the numbers keying them to a translated list did not reproduce. Furthermore, many of the Chinese characters are blurred or unintelligible because of over-reduction. In contrast the monograph has excellent population maps of both distribution and density that together with the text provide demographic detail of the type seldom available for China.

The monographs on the Inner Mongolia Autonomous Region and Kwangtung are essentially alike in organization and, to a lesser degree, in approach. The study of Kwangtung is intended partly for teaching purposes; and,

somewhat unfortunately, it tends to follow a cut-and-dried, gazetteer type of presentation. It is superior to the North China monograph in one way—the essential absolute figures are provided, but these figures are generally buried in the text and some of them are not consistent. For cash crops (but not food crops), a table of production indexes is published that gives acreages, average yield, and total production for 1952 along with projections for 1957 and 1962. Likewise, industrial production figures are given for 1952, with planned increases for 1957. About one-half of the study is devoted to a regional description in which Kwangtung is divided into five areas; these, however, are merely the five major administrative districts as of 1955—although such division does reflect in part certain significant economic and physical differences.

Although the Inner Mongolia study lacks meaningful statistics, is overly repetitious, and contains tiresome political incantations, it does provide a considerable amount of information about a relatively little known area. Particularly useful are detailed descriptions of the agricultural economy discussed within the framework of four distinctive regions. A very useful and detailed land use map is appended; other interesting maps included are a livestock series that show the percentage, by minor administrative unit, of the specific type of animal to the total livestock population; and a map that depicts, also by minor civil unit, the average number of livestock per person.

The study of the Amur and Ussuri River Regions of Heilungkiang Province is a solid, scholarly work; it is particularly satisfying because it provides some historical perspective through generous use of Japanese materials (compiled during their period of rule) and data from other pre-1949 sources. The Amur-Ussuri Region totals 185,000 square kilometers—about the size of Hupeh Province—and includes the 11 *hsien* bordering the two rivers plus Po-ching Hsien located between the Sungari and Lake Hanka. In 1956, China and the Soviet Union agreed to jointly explore and develop the Amur region. Accordingly, work has been carried out by scientists from the Academies of Sciences of both nations, including the authors of the monograph.

About one-quarter of the study consists of a description of the physical setting, with major emphasis upon climate and hydrology. The information is skillfully presented in text and tables, which support proposals for the construction of multipurpose hydroelectric plants along the middle and upper Amur and its tributaries. The remainder of the text is devoted to a detailed description and analysis of the economy of the region. A useful table lists, by *hsien*, various types of land. About 51 per cent of the region is in forests; some 18 per cent is classified as tillable land but only 13 per cent of this total was tilled as of 1955; and marshes, grazing lands, water bodies, and "others" comprise the remainder. Other informative tables with data presented by *hsien* give (1) agricultural population and farm land per farm inhabitant; (2) crop compositions expressed as percentages of total crop acreages; and (3) total production, average yield, changes in composition, and changes in unit yield (1943 compared to 1955) for the major crops.

The authors reach the conclusion that future agricultural development of the Amur-Ussuri region is dependent upon land reclamation, flood control, improved farming techniques, and the "strengthening of farm management" (p. 83). On the assumption that these necessary steps will be taken and that an estimated 1 million will be added to the farm labor force, the authors estimate that within 10 years farmed land can be increased five times and total agricultural production ten times over 1955 levels. These optimistic goals, however, are dependent, among other factors, upon improved transportation facilities. Although additional highways and railroads are needed, the key to intensive development of the Amur-Ussuri region is the linking of the Amur by canal with the Gulf of Chihli and the ports of North China.

The value of these five monographs lies not so much in the factual data they present *per se* (although this is considerable), but rather in their use as comparative tools to help evaluate the vast assemblage of unsorted and fragmentary data available from Chinese newspapers, magazines, and related sources. For this purpose the material on agriculture is of greatest use, particularly the occasional comparisons between crop yields under varying conditions of growth and culture and the statistics on land utilization. Although these figures are relatively few and fragmentary, since only parts of China are covered by the monograph series, they provide some basis for evaluating the recent extraordinary agricultural claims made by the Chinese Communists. The monographs also provide valuable population information; the population statistics by *hsien* and other sub-provincial units given in the Middle Yellow River and the Amur-Ussuri monographs will be particularly welcome, as will the urban population figures for numerous cities, occasionally including cities of less than 50,000 population. Some of the population maps should be of considerable aid in checking and revising existing population maps that are based upon pre-Communist data.

A review would be incomplete without some comment on the translations themselves. Although occasional phrases and sentences are confusing and typographical mistakes occur, the material generally reads smoothly and well. Careful editing should have caught such obvious errors as a population figure for Kwantung Province of 3,677,000 and an area for the Inner Mongolia Autonomous Region of 11,775,000,000 square kilometers! It is also frustrating to find

that the history and general geography sections for some of the monographs are not translated. The historical material that has been translated, however, is in the customary Communist vein, with an "all black" or "all white" presentation representing conditions before and after 1949. More serious is the lamentable quality of some of the maps. Laudably, all place names and legends are keyed by numbers to translated lists; but in certain cases the key numbers were so lightly drawn that they failed to stand the processes of reproduction and, usually, reduction. Too much reduction has also frequently blurred the gradations in lines and stipples used to differentiate various categories of data. These are serious drawbacks to the usability of some parts of the monographs. It is hoped that more attention will be paid to the reproduction of maps in future translations; reproduction of the photographs that accompany the monographs would be helpful.

These criticisms, however, are indeed minor when measured against the magnitude of the contribution of the Joint Publications Research Service. The service they have rendered in translating these monographs will be welcome by all who attempt to follow developments in mainland China.

PHILIP TRUE

Springfield, Virginia

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